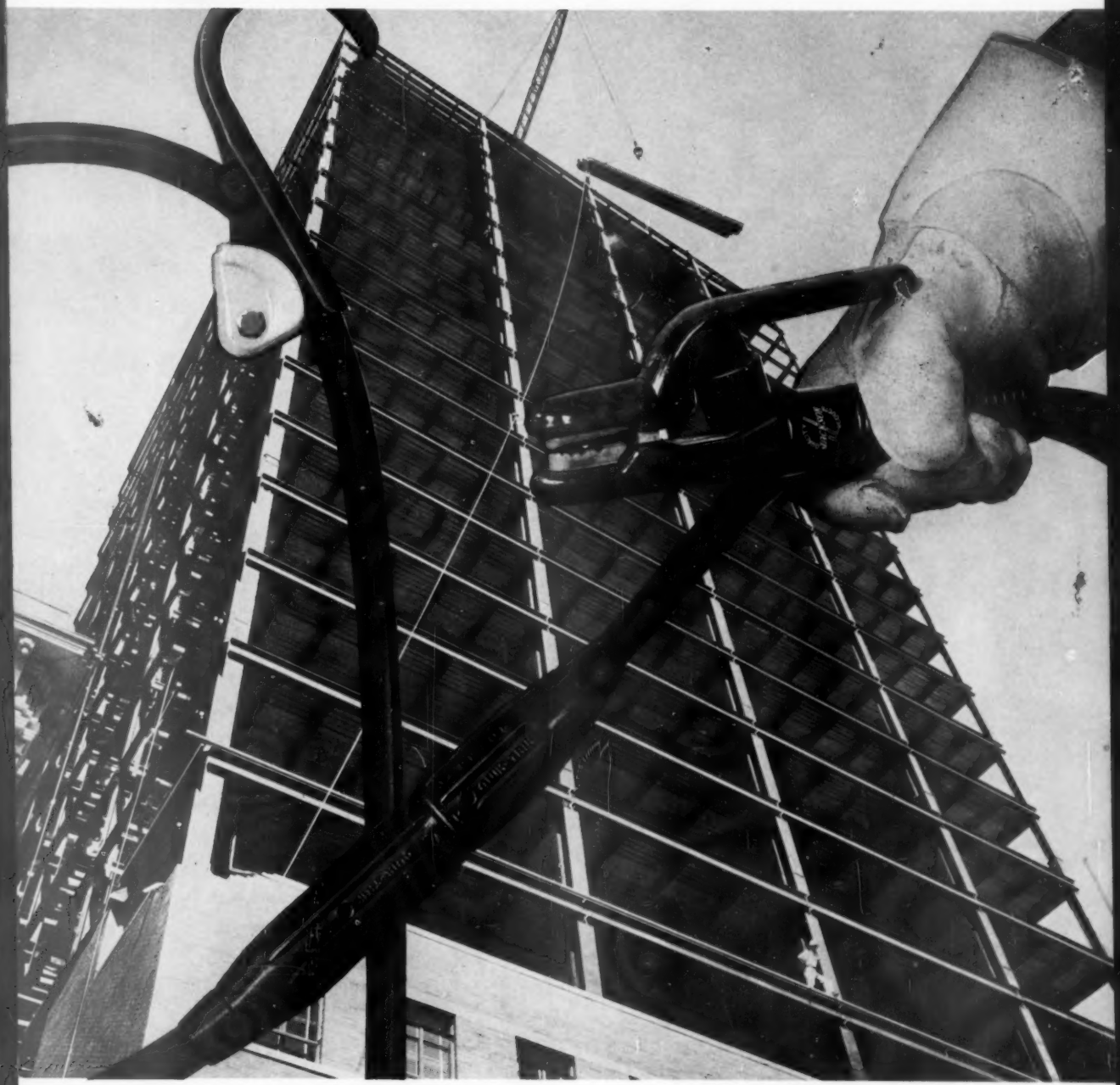
Welding Engineer

PRICE 50 CENTS

FEBRUARY, 1959



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NATIONAL WELDED PRODUCTS MONTH · APRIL 1959 ·

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Vol. 44 — No. 2

Welding Engineer

The magazine of joining and severing materials

This is welding: February, 1959

Thousands of precision welds for a sensitive giant 29

The second of two giant radio telescopes stands almost completed in California's Owens Valley: a tribute to a precision welding team. Here are full fabrication details of a job that demanded the utmost in skilled welding techniques.

A change in plans cuts costs of new Denver building 32

Merrill F. Yale tells the story of an economical substitution: welds for bolts. Redesigned at the suggestion of the erector, the new State Services building was constructed with sizable savings in material and shop labor costs, as well as in time.

A guide to nuclear power—III 34

W. D. Biggs discusses metallurgical problems encountered in the fabrication of nuclear reactors. In this third of a four-part series, aspects of design and construction in relation to properties of conventional mild, alloy and stainless steels are considered.

New storage vessel features thinner plate, improved capacity 38

Chicago Bridge & Iron Co. designers utilized a well-known principle in formulating plans for three noded Hortonspheroids recently completed for Phillips Petroleum. **Raymund V. McGrath** outlines both design factors and field welding operations.

Flames buckled this steel, and flames straightened it 40

One of the nation's most extensive flame-straightening jobs—on the flame-wracked structure of hangars 1 and 2 at McChord Air Force Base—is treated in detail in this first article in a special *WE* series by **Jack Fairlie.**

New pipeline welding method makes U. S. debut 44

The "magnetic girdle" introduced to an oil-industry audience in Houston won't cling magically to a feminine form—but what it does to a pipe joint seems magical enough.

Plasma heat: newest in welding's product lineup 50

How hot is 20,000 F? Here's the answer to this and other questions relating directly to the properties of a new torch operating on plasma (ionized gas) and affording the user a heat range of 3,000 to 30,000 F.

Also in this issue:

Submerged-arc builds California's first railroad bridge 37
Reynolds sponsors welded aluminum bridge 48
One weld: 160 passes, 3½ days, $5,700 54
Electronic tracing: Cost-saver for flame-cutting 56
Welding vital in Hopkins Laboratory 59

Regular **WE** features . . .

News 7
Your WeldWorld at press time 13
Letters 20
Between passes 25
Editorial: *Once again*—rules! 27
On the job 60
Welding Clinic: *Preheating methods* 62
Data Sheet: *Computing electrode purchases* 65
New products 66
People 80
30 years ago 83
Free literature 84
The Welding Shopper 87
Advertisers in this issue 88
Literature offered in ads 88
Welding Info-Aids 89

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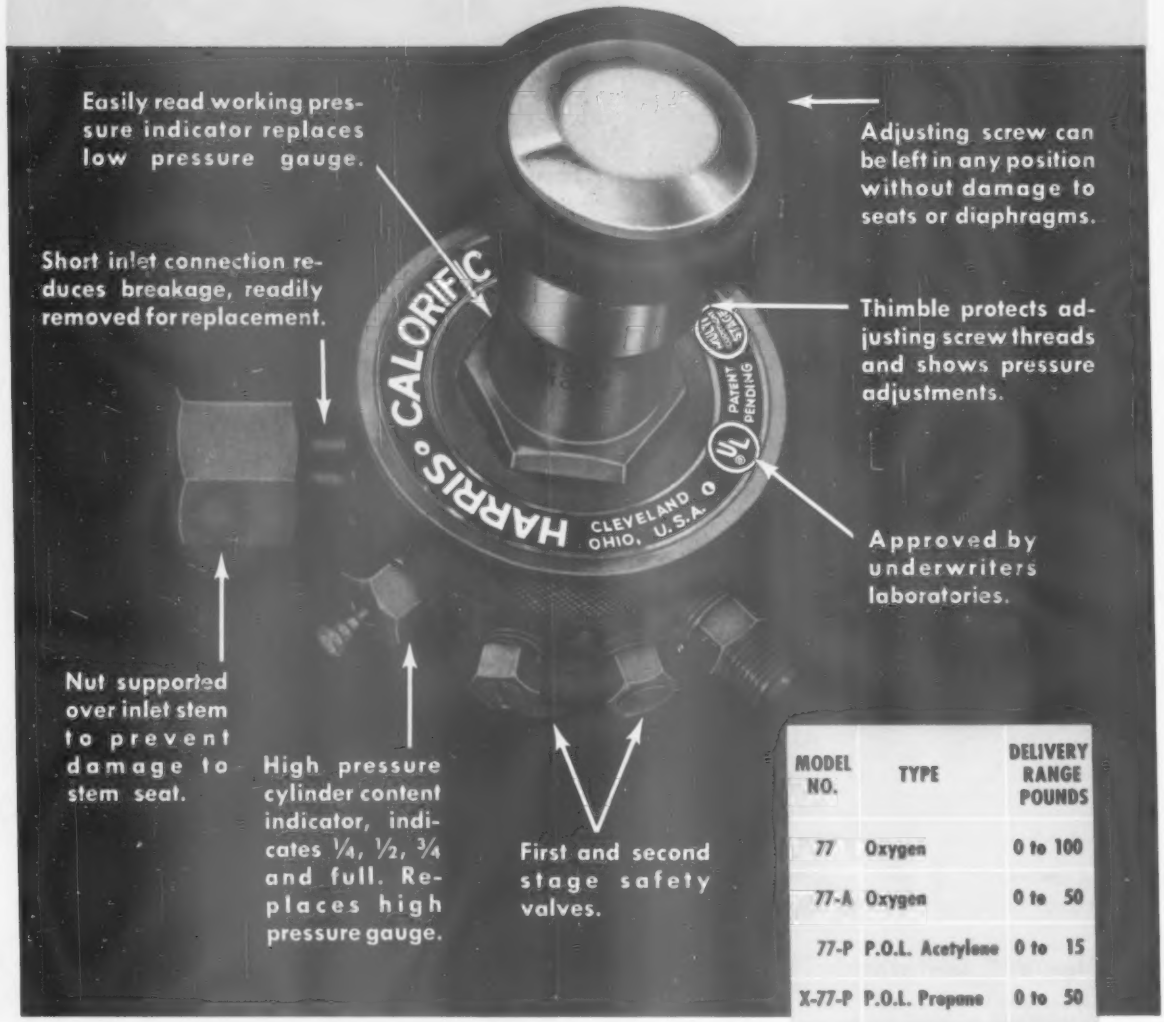
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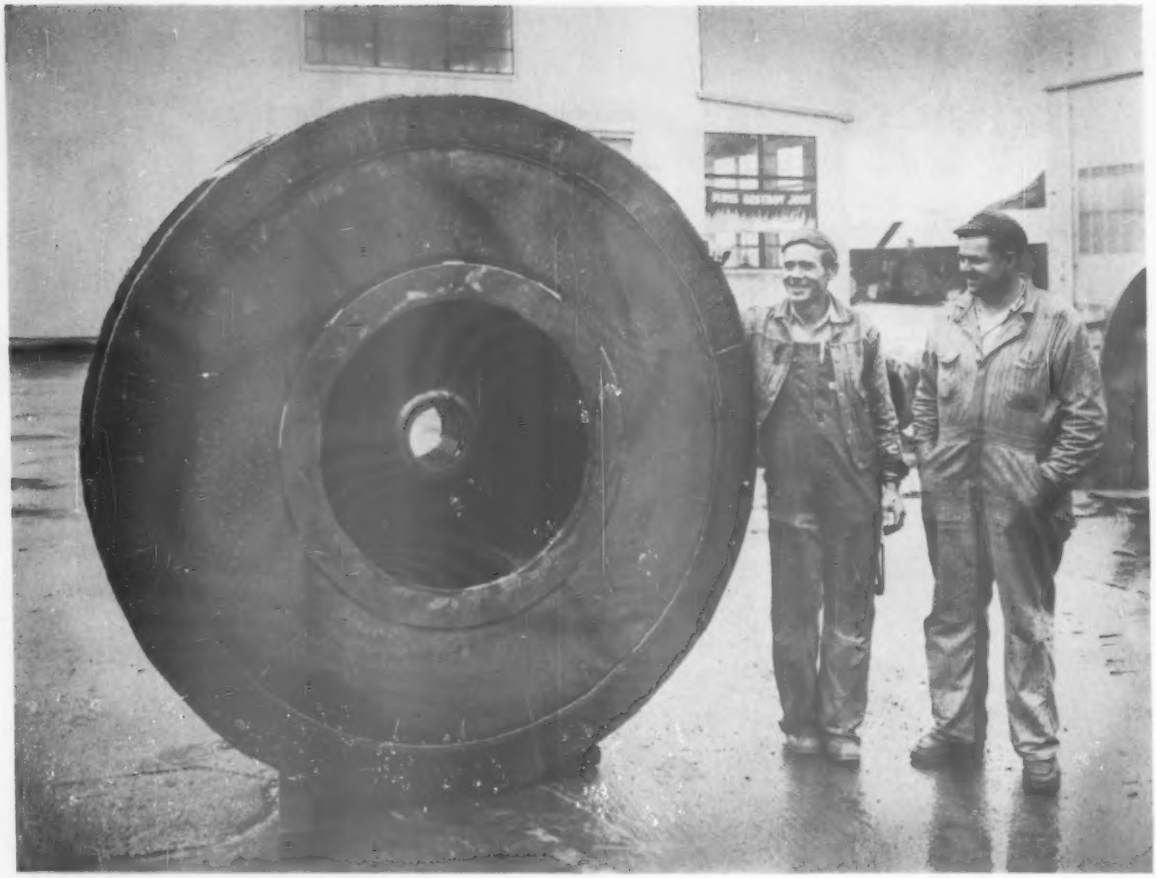
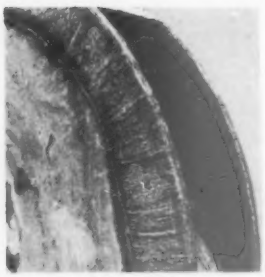


Cuts hardfacing time in 1/2 with Victor semi-automatic Wire



When this 84" dredge pump impeller's action became sloppy from 250,000 cu. yds. of abrasive river material, The Corps of Engineers at Portland, Oregon, built it back to proper size and shape with Victor semi-automatic hardfacing wire.

For the multiple build-up required, welder Maynard Berry (left in photo) used Victor VA-4X 7/16" wire. Then he deposited a top pass with VA-0 7/16" wire, especially resistant to abrasion. Photos here show how neatly he and Victor semi-automatic wire did the job.

Reports welding foreman D. L. Brumbaugh:

"One-half the hard-facing time was saved. We have had exceptionally good quality weld deposit with Victor and we like its running quality."

You, too, will find it pays to renew worn equipment with Victor hardfacing alloys. Complete range of types and sizes for both acetylene and electric AC and DC applications, either automatic or hand. Order from your Victor dealer TODAY.

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NEWS

Engineers Council accredits Ohio State welding course

Ohio State University's welding engineering course is the first to be accredited in the United States by the Engineers Council for Professional Development. (See *Welding Engineer*, January, p. 29.)

Since 1932 the Council has been the only coordinating agency concerned with accrediting engineering curricula. When asked, a Council committee visits a university and examines records, staff policies and capabilities to determine if accreditation should be granted.

Welding was first taught at Ohio in 1893 when courses on welding steel by forging were introduced. Gas welding and cutting were added in 1919. In 1947 the curriculum for the degree of bachelor of welding engineering was approved by the University and the first welding department was established under Prof. Robert S. Green.

Prof. R. B. McCauley, chairman of the department since 1954, says the accrediting will help move the field of welding engineering closer to national acceptance as a professional engineering group.

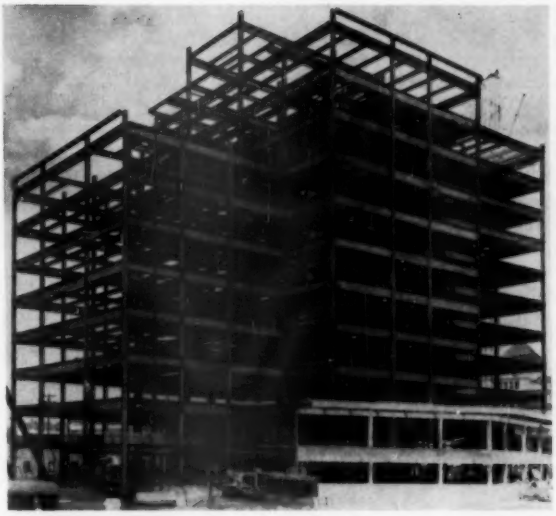
Nine laboratories and a welding library comprise Ohio's department. The laboratories are for heat treating, design, testing, metallurgy, preparation, welding processes, welding research, radiation and photography. The A. F. Davis Welding Library consists of 7,000 volumes on welding and related fields, and a classification system for welding patents.

The department, in addition to its college training, offers courses for industrial and off-campus personnel during the school year, and workshops during the summer.

Union Carbide to build service laboratory

George A. Fuller Co., New York City, has been awarded a contract for the general construction of Union Carbide Chemicals Co.'s East View, N. Y., technical service laboratory.

The laboratory, first of a $12,000,000, four-building project in East View, will house 50 individual laboratory units, offices and a 200-seat auditorium. Research on new products and the solving of customer's problems will be handled in the building.



SKELETON of Sedgwick County Court House, Wichita, Kan. Welding was used to connect spandrel beams to columns and in constructing floor deck.

Welding used to construct court house skeleton

Another example of welding used in construction is the Sedgwick County Court House being built in Wichita, Kan. Continuous welding was used to connect all spandrel beams to columns and in fabrication of floor deck.

Workmen needed 3,108 tons of structural steel and 10,000 lb of E6010 welding electrodes to construct the building's skeleton. Electric and gas driven 200-amp welders were used.

The state's largest office building will cost more than $7,500,000 by the time it is completed in December. It covers 360,000 sq ft, is 11 stories high, and will house all county offices and courts and the county jail.

The building is designed so six stories and a roof can be added when the county's population climbs above 500,000.

Martin K. Eby Construction Co., Inc., Wichita, is general contractor and steel erector for the building which was designed by Thomas-Harris-Calvin & Associates. Structural engineer is G. Hartwell & Co.

Western Metals Show to be held March 16 to 20

New alloys and fabricating processes for general industry, aircraft, rockets and electronics will be emphasized at the American Society for Metals 11th Western Metals Exposition in Los Angeles' Pan-Pacific Auditorium, March 16 to 20. The Metals Congress will be held at the same time in the Ambassador Hotel.

IAA to hold annual convention in South

The International Acetylene Association will hold its annual convention in the Hotel Roosevelt, New Orleans, March 9 and 10.

Chemical, safety and business sessions will be held. A board of directors luncheon and Morehead Reception and dinner will round out the day-and-a-half meet.

Linde releases Tig welding film

Linde Co., New York City, has recently released an 8-minute sound and color 16 mm motion picture designed to show beginners the basics of Tig welding.

Pieces of equipment, how to make a weld, and results that can be expected after practice are shown. The movie is available, free, from any company office.

Army drafts aluminum for ordnance vehicles

Pacific Car & Foundry Co., Renton, Wash., is making prototypes of a new personnel carrier for the Ordnance Corps., U. S. Army. The T-116 carrier is being constructed from 5086 aluminum alloy developed by Kaiser Aluminum & Chemical Corp., Oakland, Calif.

The vehicle was developed for use on all types of terrain in any weather conditions. It is amphibious and light enough to be transported by air.

The 5086 aluminum sheet used in fabrication is said to have high welded strength and high corrosion resistance. Weldments are being made with inert gas methods using 5356 wire. *WE* sought further welding details, but was unable to obtain them because of Army restrictions.

Essex to hold welding show

A. C. Axtell, president of Essex Welding Equipment Co., Newark, says he expects from 2,500 to 3,000 persons to attend his company's welding show to be held Feb. 4 to 6.

Thirty-four manufacturers have been asked to participate in the show with either live demonstrations or displays.

At this writing 20 firms say they will participate. They are: All-State Welding Alloys Co., Inc., Arcair Corp., Bay State Abrasive Products Co., Contour Marker Corp., Fibre Metal Products Co., Frommelt Industries, Gates Rubber Co., Glendale Optical Co., Jewel Mfg. Co., Lenco Inc., Manufacturers Brush Co., Sylvania Electric Products Inc., Tec Torch Co., Inc., Tempil Corp., Thor Power Tool Co., Vacu-Blast Co., Victor Equipment Co., Whitehead Metals Inc., Worthington Corp., and Hobart Bros. Co.

Corrosion Show to start March 17

The 1959 Corrosion Show will be held March 17 to 19 in the Sherman Hotel, Chicago, concurrently with the 15th annual Conference of the National Association of Corrosion Engineers.

To date, 79 companies have reserved 103 exhibition booths. Among exhibitors will be Aluminum Co. of America, International Nickel Co., Inc., Johns-Manville Sales Corp., Magnaflux Corp., Metal & Thermit Corp., Metallizing Engineering Co., Inc. and Phelps Dodge Copper Products Corp.

Wiley heads college welding department

Richard C. Wiley, former chairman of the Welding Dept. of California State Polytechnic College, San Luis Obispo, has been named head of the school's new Welding and Metallurgical Engineering Dept.

Wiley, a member of the AWS, ASME and ASM, has been a welding engineer or consultant with Joshua Hendy Iron Works, Bechtel Corp., Linde Co. and X-Ray Engineering Co.

The first two years of the new curriculum will be offered beginning in September. The third year will be added in 1960, the fourth in 1961.

Whitehead Metals Inc. company's new name

Whitehead Metal Products Co., Inc., New York City, has changed its name to Whitehead Metals Inc. The company distributes aluminum and stainless alloys, and other metals.

COMING EVENTS

MARCH 9-10: IAA 1959 Convention, Roosevelt Hotel, New Orleans.
MARCH 12: NEMA Arc Welding Section Quarterly Meeting, Pittsburgh.
MARCH 16-20: ASM Western Metal Exposition and Congress, Pan-Pacific Auditorium and Ambassador Hotel, Los Angeles.
APRIL 7-10: AWS Welding Show, International Amphitheater, Chicago.
APRIL 18-22: ASTE Annual Meeting, Schroeder Hotel, Milwaukee.
MAY 4-6: NWSA Annual Convention, Fairmount Hotel, San Francisco.
MAY 25-28: Design Engineering Show and Conference, Convention Hall, Philadelphia.
JUNE 4-5: NEMA Arc Welding Section Quarterly Meeting, Hot Springs, Va.
SEPT. 28-OCT. 1: National Fall Meeting of the AWS, Detroit.
NOV. 2-6: 41st National Metal Exposition and Congress, International Amphitheater, Chicago.

Eutectic to expand research facilities

"The company lacking a fully developed and adequately financed research program will be at a serious disadvantage within two or three years," says Joseph Quaas, vice president of manufacturing and production for Eutectic Welding Alloys Corp., Flushing, N. Y.

Keeping this prediction in mind, Eutectic is planning a $1,000,000 program, to start this year, for the expansion of its research, development and technical service facilities.

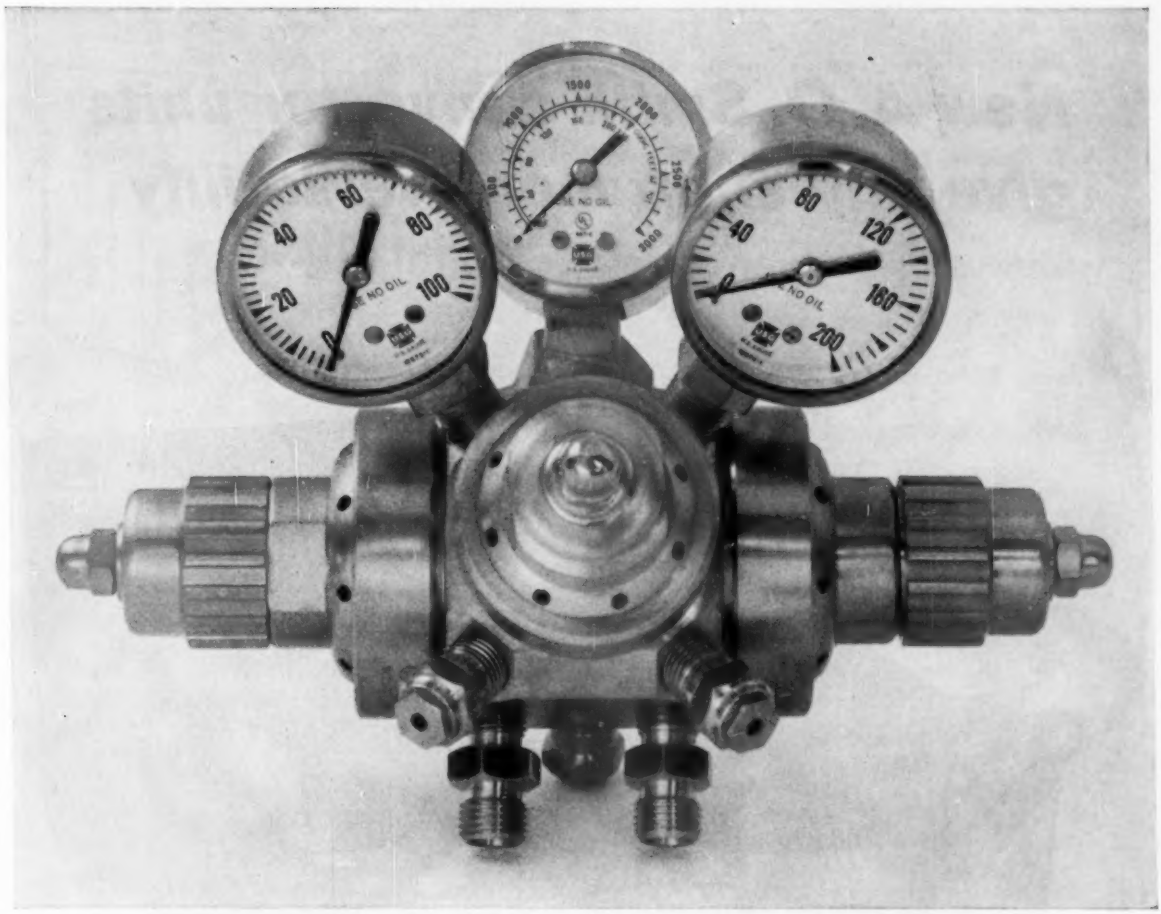
More research and development laboratories to further metallurgical and

(Continued on page 75)

Then . . . . . and now

HARNISCHFEGER Corp. is celebrating its 75th anniversary. This is original shop in which Henry Harnischfeger and Alonzo Pawling started business operations at Milwaukee in 1884. At right is company's main plant where welding positioners and other equipment are manufactured. Company now has eight plants in U. S. and affiliates overseas. Going into its 75th year, the firm has produced 85,000 welding machines and more than 600,000,000 lb of electrodes. Similar astronomical figures represent company's production of its other products.

For Three Hose Cutting Torches . . . SEPARATE REGULATION



THE NEW TRIPLEX OXYGEN REGULATOR for three-hose flame cutting torches.

Here is a brand new regulator combining into a single unitary body one high pressure stage and two individually adjustable low pressure stages; one low pressure stage to control the preheating flame oxygen and the other one for the high pressure stream of cutting oxygen. The regulator is provided with two outlets, three self-reseating relief valves to protect each individual stage and one inlet. Three 2½" diameter gauges indicate respectively, the low pressure oxygen stream, the high pressure oxygen stream and, the center gauge, the cylinder or cylinder bank pressure. The regulator body and caps are machined of dense brass bar stock, and all internal working parts are interchangeable with all other standard regulators of comparable diameters made by our company. This new Model 5-121, National Triplex Safety Regulator will be of interest to all companies operating three-hose machine cutting torches — write for catalog FORM #16.

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to d-c in 60 seconds!

New way to up flexibility

Now, with either of two A. O. Smith convertor units, *any* a-c welder in your plant can be quickly converted to all of your d-c welding needs.

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And, as indicated below, you can hook up these convertors in a matter of seconds — for temporary, intermittent or permanent operation.

*** No matter which make a-c welder you currently use, here are advantages A. O. Smith convertors offer—**

- Complete polarity switch permits fingertip selection of d-c straight, d-c reverse or a-c current without touching leads.
- 250-amp unit is rated at 60% duty cycle or 300-amps at 40% duty cycle. 450-amp unit is rated at 60% duty cycle or 500-amps at 45% duty cycle.
- Completely self-contained — not special kits designed for specific welders.
- Easily portable — can be kept in the tool crib . . . quickly delivered wherever needed.
- 60-second hook-up — two cable connections to welder output, two connections to the work.
- Internal overload protection.
- Smoothing reactor to keep ripple low, arc stable.
- Blower-cooled for maximum cooling, quiet operation.
- Long-life *silicon* rectifiers.

If you don't have an a-c welder, you're missing a lot in welding flexibility. It's time to check the line of A. O. Smith a-c welding machines: 180-1500 amps.

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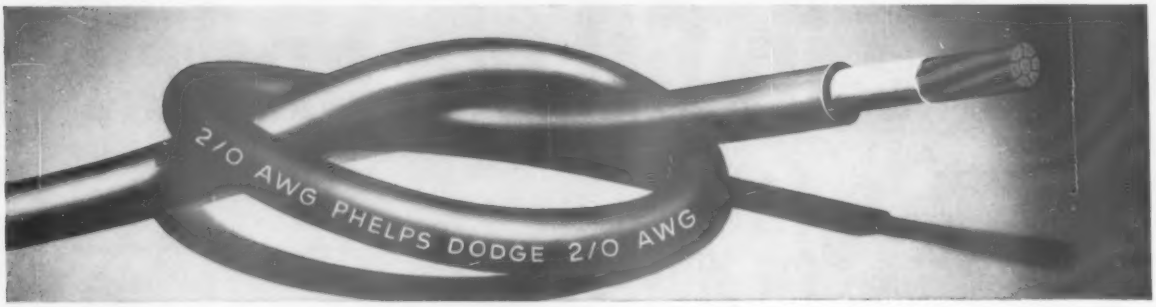

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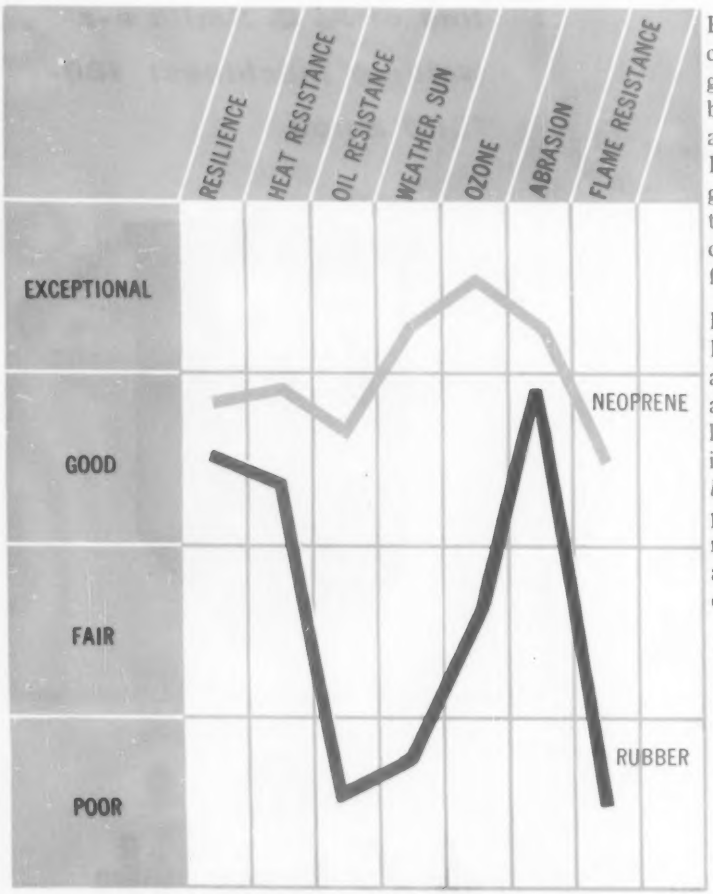

(Adapted from chart of Elastomer Chemical Dept., E. I. du Pont de Nemours & Co., Inc.)

Phelps Dodge Habirprene arc welding cable combines maximum flexibility with the greatest resistance to deterioration caused by exposure to harmful physical, chemical and mechanical conditions. The ability of Habirprene welding cable to withstand greater overall wear and tear, as compared to rubber welding cable, is shown in this chart compiled from comparison tables of four rubber goods manufacturers.

Phelps Dodge pioneered the fabrication of Habirprene welding cable, the first real advance in this field, more than 10 years ago. Records show that Habirprene cable lasts much longer than rubber cable and—in some applications—as much as *four times longer!* Although the initial cost of Habirprene is slightly higher, it will more than repay you in long-time service. Habirprene arc welding cable meets full requirements of A. S. T. M. D752.

See your authorized Phelps Dodge distributor for Habirprene arc welding cable with the indelible gold markings—the sign of higher quality, longer-lasting cable.

Phelps Dodge also makes a full line of rubber arc welding cable and welding power supply cable. All the above cables are available from stock.

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1959

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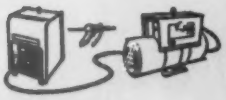
Last minute news of interest to those engaged in joining and severing materials.



. . Liquid Carbonic Div. of General Dynamics Corp., Chicago, has acquired Industrial Air Products of the South. Latter will operate under management of Liquid's Southern Region, Atlanta. Included in the acquisition: two plants manufacturing oxygen and acetylene in New Orleans and Pascagoula, Miss., and warehouses in New Orleans, Baton Rouge, Houma and Morgan City, La.

. . Emerson Electric Mfg. Co., St. Louis, in stock trade has taken over Imperial Lighting Products Co., Latrobe, Pa. New subsidiary will be known as Emerson-Imperial Lighting Co.

. . Crucible Steel Co. of America has withdrawn from stainless-steel electrode business, but will continue to sell core, spooled and layer-wound wire and other stainless wires in regular mill coils. Crucible remains in the hardfacing line with its Rexweld products.

. . Linde Co. has released for sale its portable liquid-oxygen cylinder--the LC-3--which up to now had been leased only to its distributors.

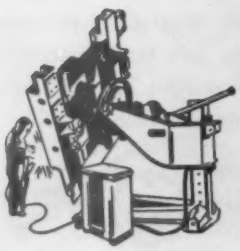
. . General Cable Corp., New York City, has acquired Cornish Wire Co. of New York.

. . Stock exchange deal has enabled Combustion Engineering, Inc., to acquire General Nuclear Engineering Corp., which will be operated as a subsidiary.

. . Several industry spokesmen are predicting that 1959 output of steel should top 1958 production by at least 25%...which should bring operations up to about 80% of capacity.

. . Electronic tube industry is looking for sales increases ranging from 5 to 10% over 1958 dollar volume, according to L. B. Davis, general manager of G-E's Electronic Components Division.

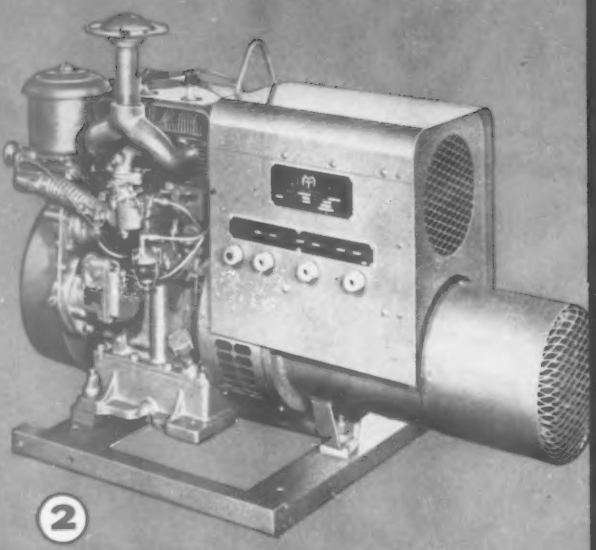
. . Secretary of Commerce Lewis Strauss says about the overall economy: "Although most economic indicators report progress, a few still lag...substantial overall gains made at end of 1958 establish an upward momentum which can be expected to carry the economy to new levels in 1959."



THREE NEW M & T WELDERS FOR DEPENDABLE POWER

.....in the field

.....in the shop



2

1

3

1. LIQUID COOLED—ENGINE-DRIVE WELDER – Heavy duty, gasoline engine driven welder with simplified control – one dial for electrode size, one dial for current setting. Three available models—200 amp., 300 amp., 400 amp. —deliver long, trouble-free service.

2. AIR COOLED—ENGINE-DRIVE WELDER – Light weight, gasoline engine driven welder for field or shop service. Low cost, compact, readily portable and inexpensive to operate. Simplified control permits stepless current adjustment within selected range from 25 amp. to 200 amp.

3. MOTOR-GENERATOR WELDER – Heavy duty, DC motor-generator welder designed primarily for manual arc welding. Compact, functionally designed. Power factor control keeps power costs down. Low maintenance reduces operating costs. 300 amp. and 400 amp. models available.

For fast-starting dependable power specify M & T welders. Complete information on request. Write Metal & Thermit Corporation, Rahway, N. J.

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PARTNER IN WELDING PROGRESS SINCE 1904

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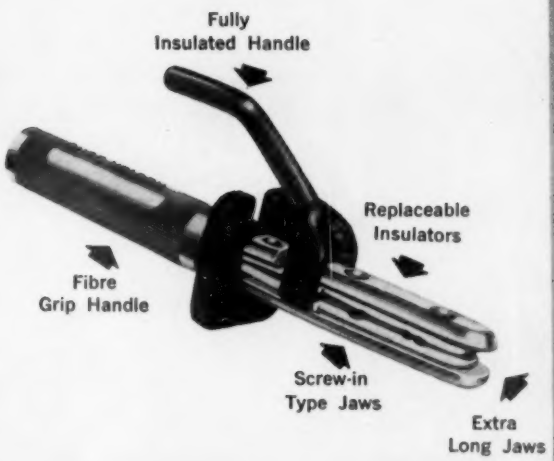
PRODUCTS FOR BETTER WELDING

For 27 Years Preferred By Welders

THE DURO "STANDARD"

- All Parts quickly replaced with a screwdriver
- Screw-in type jaws — No tools required
- Insulated Handle and Guard — Protects operator
- Rugged Fibre Handle — Lasts longer
- Cool Operation — Cool Handling

Featuring "Long Jaw design" for reaching those "hard to get at places"



The New Duro "DUROGON" Tong-Type

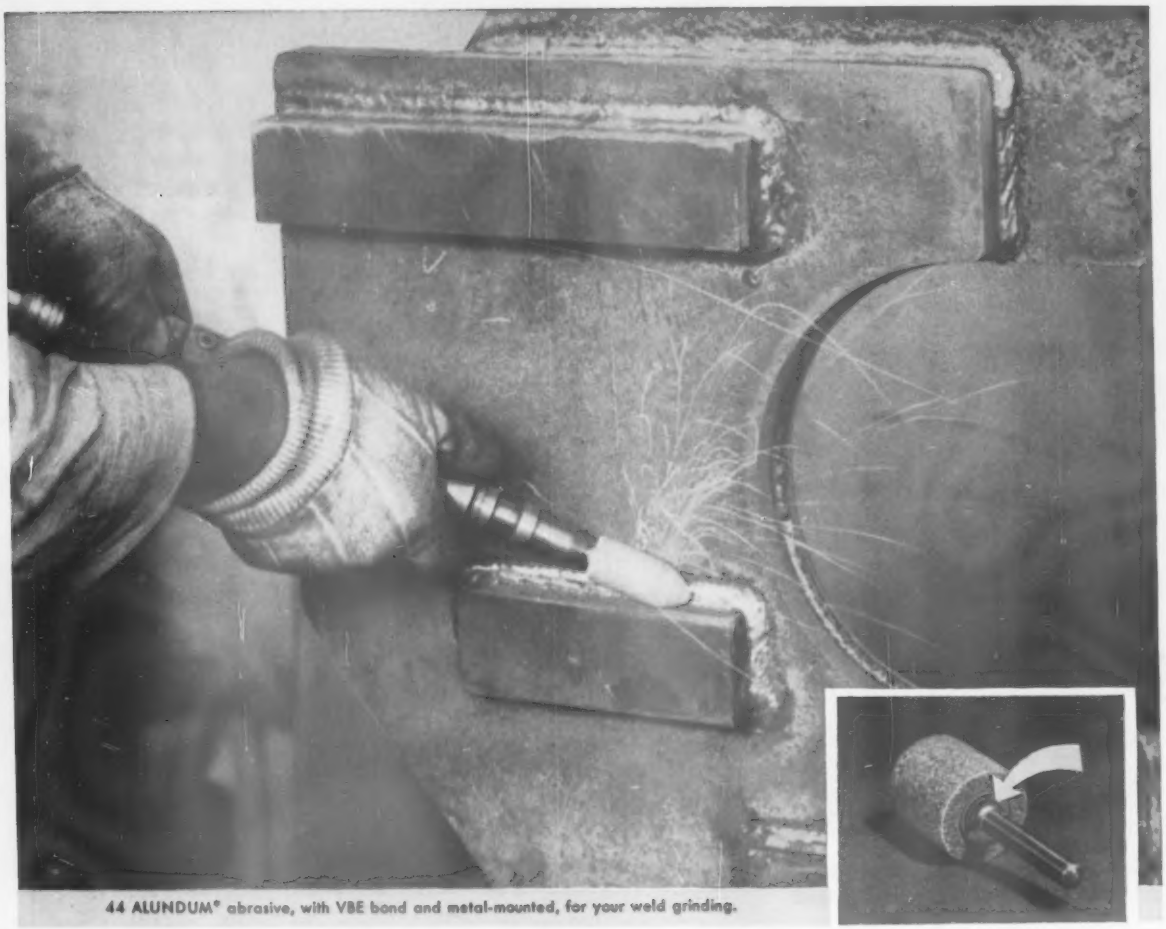
THE DUROGON-N3 and N3HD

- All Parts quickly replaced with a screwdriver
- Fully Insulated — Greater safety
- Cool Operation — Cool Handling
- With ALUMINUM Body — Less operator fatigue
  Mechanical Cable Connection
- With BRONZE Body — For heavy duty operation
  Mechanical, soldered or brazed connection

"The BEST of this Popular Design!"

DURO

ENGINEERING COMPANY · 31 OREGON AVE. · HAMDEN, CONN.



44 ALUNDUM® abrasive, with VBE bond and metal-mounted, for your weld grinding.

Here's how Norton keeps

"Making better products to make your products better"

In weld grinding, as throughout their entire job range, Norton mounted wheels are hitting new highs in grinding efficiency.

Outstanding new developments in abrasives and wheel construction eliminate loading and glazing — besides giving you the fastest cutting rate, with a marked increase of stock removed per wheel.

These advantages are the natural results of Norton Company's long experience in engineering mounted wheels for best performance in every application—from tool and die finishing to all kinds of rough grinding.

For weldments and steel castings, mounted wheels of 44 ALUNDUM abrasive, with VBE bond and metal-mounted, are unequalled. "44" grinds better than other non-premium priced abrasives because it's made differently, for extreme toughness. And the VBE vitrified bond assures the ideal structure for mounted wheel weld grinding.

METAL-MOUNTING — Another Norton Exclusive — You throw nothing away but the mandrel!

Norton does it again! . . . The mounted wheels are so securely anchored to the mandrel — *you use all of the abrasive!* No waste . . . all work! This radically improved method of locking the abrasive body to the mandrel is used on mounted wheels in most sizes and shapes, 5/16" diameter and larger. Molten metal, injected into the abrasive recess at high pressure, does it — and does it fine!

Every Norton mounted wheel is accurately trued *after mounting* on rust-proof stainless steel mandrels. Developed to increase the time-and-money-saving "Touch of Gold", Norton mounted wheels are stocked in approximately 200 standard shapes and sizes. See your Norton Distributor for prompt deliveries.

Or write to NORTON COMPANY, General Offices, Worcester 6, Mass. Plants and distributors around the world.

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

W-1887

NORTON ABRASIVES

Making better products . . . to make your products better

NORTON PRODUCTS Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electrochemicals — BEHR-MANNING DIVISION Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

QUICK SWITCH TO AIRCO 3 TUBE CUTTER ...and you're in BUSINESS!

Triangular stack design gives Airco Cutting Attachment rigidity for extra-long service life

Put this new Airco torch on your toughest, most abusive jobs. It stands up better than any previous 3-tube cutter—or any existing 2-tube cutter.

Go from WELDING to CUTTING in seconds! Twist!—Airco welding tip-mixer assembly is OFF. Twist!—new Airco 3-Tube Cutting Attachment is ON! You don't need a wrench.

Gases mixed in tip! That's right – new Airco 3-Tube cutter mixes the gases right in the tip. No premixing. No leakage. No flashback.

Slice 8" steel! Get Airco Model 3800 to cut steel up to 8"—fits Airco 800 welding torch. Get Airco Model 3700 for steel up to 6" on your 750 Airco torch, or up to 4" on your 700 Airco torch. Both 3800 and 3700 take practically all Airco ¾" seat tips.

There's no better time than right now to try your first Airco 3-Tube Cutting Attachment. Phone for a demonstration. For the name of your nearest Authorized Airco Dealer, look in the Yellow Pages of your telephone book under "Welding Equipment and Supplies." Or call your nearest Airco office.

AIRCO®

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Cuban Air Products Corporation

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Air Reduction Canada Limited

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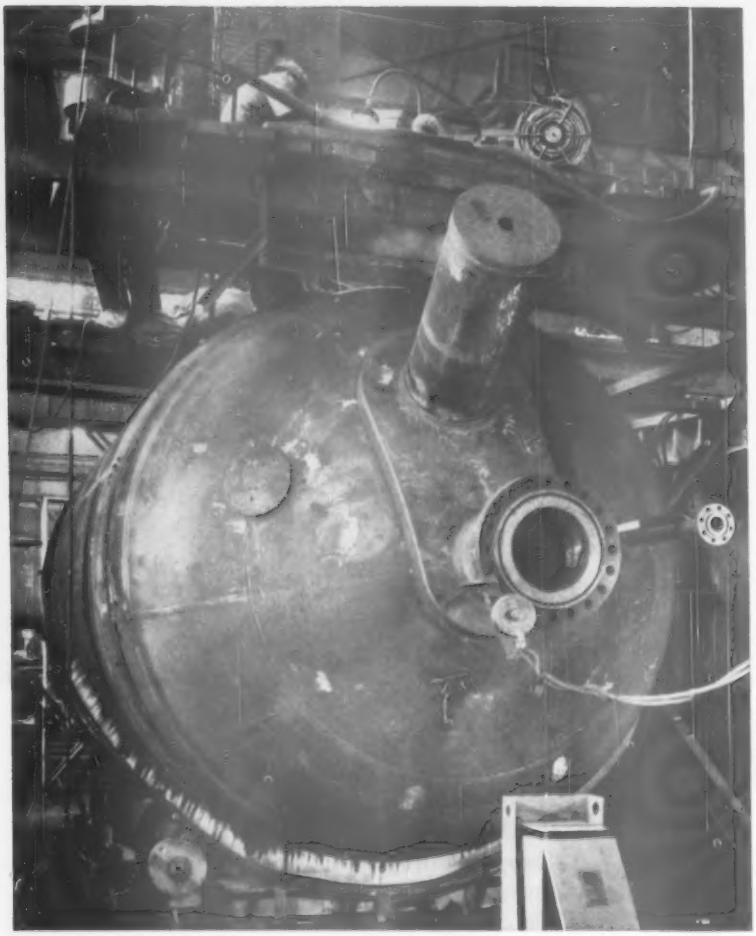
For any stainless welding job

SPECIFY **Drawalloy** CORPORATION

Stainless Steel Welding Wire



Spooled for Inert Gas Shielded Metal Arc Welding

Coiled for Submerged Arc Welding

Cut Lengths for Inert Arc Welding

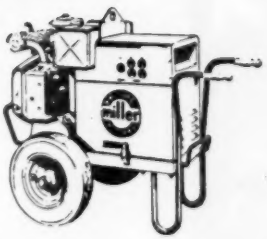
Specify Drawalloy "quality controlled" stainless steel welding wire for *your* next "quality weldments." Your greatest advantage is experience . . . our experience in producing wires for welding exclusively. Because we are specialists, Drawalloy stainless steel welding wire is produced to strictly controlled specifications to provide the right chemistry, finish and temper for the finest quality weld metal and smoother operation in your automatic or semi-automatic equipment. Drawalloy stainless wires are available in all popular grades as well as 2¼ Cr, 1 Mo; 1¼ Cr, ½ Mo.

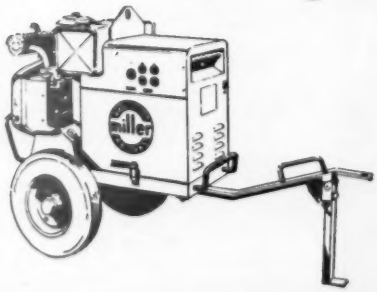
Why not discuss your stainless welding wire needs with your Drawalloy Distributor or Representative . . . a man with the products and knowledge to help you. Bulletin 355 DC provides complete information on every grade of Drawalloy wire. Write to: Drawalloy Corporation, Lincoln Highway West at Alloy Street, York 12, Penna.

DRAWALLOY
CORPORATION
YORK, PENNSYLVANIA

THE WIRE MILL FOR THE WELDING INDUSTRY — STAINLESS STEEL · TOOL STEEL

The Engine Driven Welder/Power Plant with the 100% DUTY CYCLE





An original Miller design with performance standards, ruggedness and versatility that have made it a top hand from the Texas oil fields to New York dairy farms. Because, whether the AEA-200-L is hub deep in mud welding a derrick brace, or supplying power for lights and milking machines, or answering an emergency call aboard a repair ship. . . . IT DELIVERS. Currently a best seller in the highway construction market, the Miller AEA-200-L is handily the "finest in the field," and here's why:

- All-weather construction
- Onan 12.9 h.p. air-cooled engine coupled directly to generator
- Full 225 ampere output
- 100% DUTY CYCLE
- 5 KW, 115-230v ac
- 1 KW, 115v auxiliary dc
- Uses any ac or ac-dc 1/16" to 3/16" electrodes
- Seven station amperage selection with continuous current control

Other Miller welder/power plants for metallic arc and TIG welding to 350 amperes.

Complete particulars will be sent promptly.

miller ELECTRIC MANUFACTURING COMPANY, INC., APPLETON, WISCONSIN

Distributed in Canada by Canadian Liquid Air Co., Ltd., Montreal

EXPORT OFFICE: 250 West 57th St., New York 19, N. Y.

ATLAS... FIRST AGAIN!

NOW YOU GET 18% MORE CHIPPING EFFICIENCY ALONG WITH OTHER BIG ATLAS ADVANTAGES!

Everybody benefits from an improvement like new "WIDE BLADE," the welder, the owner of the business and even Atlas because new names will be added to the thousands already on our customer list.

Why is Atlas always first with chipping tool innovations? It's simple as this—We are specialists. This is our principal business, not a side line. We are constantly looking for ways to improve weld cleaning techniques—to speed the job and do it better at less cost. Every member of the famous Atlas Line now has "WIDE BLADE," tool

Ask your welding supply dealer to show them to you.

33 MODELS THEY ALL HAVE WIDE BLADES

WIDE BLADE

HERE'S WHAT 18% MORE BLADE WIDTH MEANS TO YOU

This much more weld cleaned in the same amount of time with the same amount of effort.

Sharpen less often. Tools last longer and non-productive time saved.

It's like getting a free tool every time you buy five, because the new wide blades wear longer.

ATLAS WELDING ACCESSORIES INCORPORATED
707 E. LEWISTON
FERNDALE 20, MICH.

Letters . . .

Letters should be addressed to: The Editor, WELDING ENGINEER, P. O. Box 28, Morton Grove, Ill. No letter will be published unless signed, but your name will be withheld if requested.

Information provided

La Mesa, Calif.

Sir:

I have been a subscriber for eight or nine years, and would like to renew my subscription for another three years. The many wonderful articles on welding and fabrication of many types of metals have helped me in my work time and time again.

Herman M. Williamsen

Data sheets

Washington, D. C.

Sir:

I feel sure other readers of *Welding Engineer*, as myself, appreciate the assistance you are giving the industry by including in your magazine such technical data charts as the Engineering Data Sheets . . . I want to express my appreciation to you for the fine job you are doing with *Welding Engineer*.

W. F. Ruehl, Manager
Southern Oxygen Co.

A treat

Youngstown, O.

Sir:

I've been reading other people's copies of the *Welding Engineer* long enough. I'll treat myself to a year-around Christmas present—attached is my check for $5 for a three year subscription.

W. A. Shields
Engineering Service Representative
Linde Co.

Jacksonville, Fla.

Sir:

Will you please change our address . . . incidentally, I would like to take this opportunity to tell you how much I enjoy your very informative publication.

W. R. Lawhon
Linde Co.

Here it is!

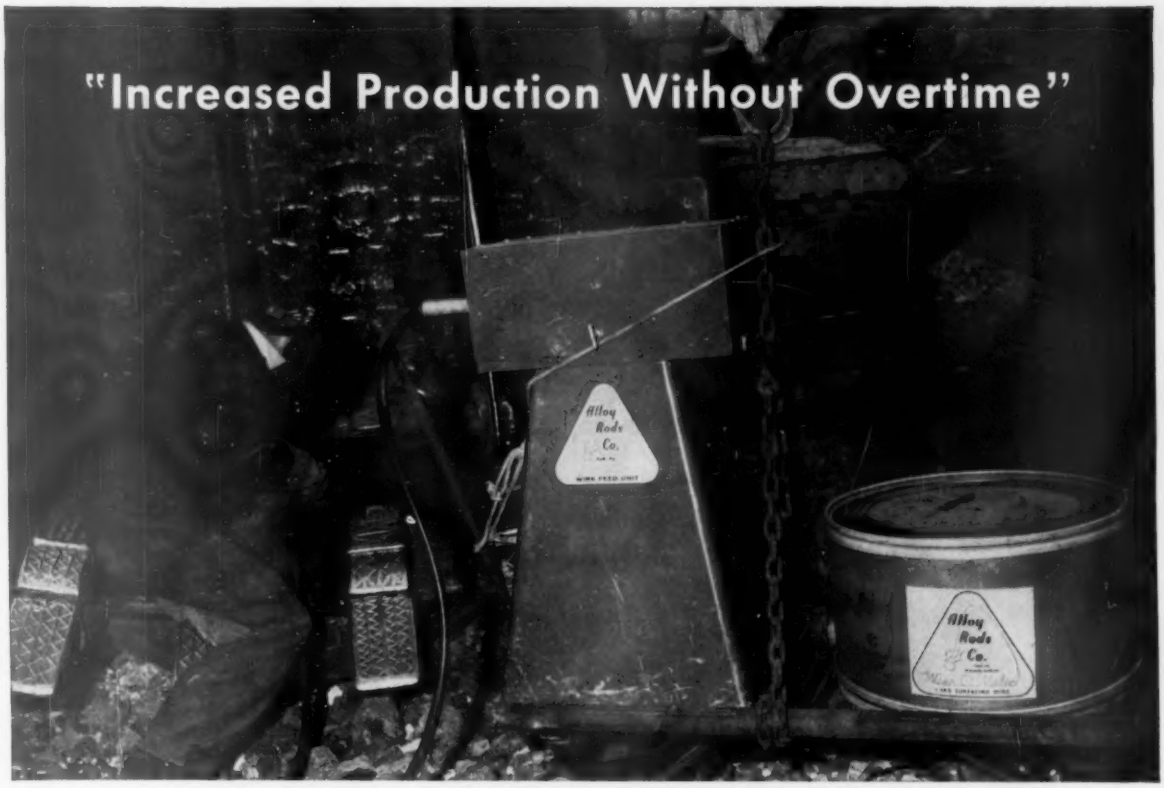
Battle Creek, Mich.

Sir:

Will you please tell me where I can get information regarding the magnetic girdle welder for pipe, as mentioned in the January *WeldWorld*.

James R. Cooper

—*Turn to page 44 of this issue.*



Hard Surfacing Semi-Automatically with WEAR-O-MATIC Yields Big Production Dividends for Custom Shop

The 5½ yard bucket shown above is being built up with Wear-O-Matic Nickel Manganese. This is a vertical weld on one of the grizzlies in the bucket. Over this will be deposited one pass of Wear-O-Matic 15. Perry Westlake has cut in half the time required on a job like this by using the Wear-O-Matic process.

Perry Westlake, Owner, Westlake Service, Burgettstown, Pennsylvania, does his best work while other men sleep. His custom hard surfacing of equipment must be done between shut down time at night and start up time next morning. This rigorous schedule has been the downfall of many contract weldors. Westlake solved this problem with the new Wear-O-Matic Semi-Automatic Hard Surfacing Process. "It would take an additional gasoline driven DC welding machine and another trained hard surfacing weldor to turn out the production we now get using the Wear-O-Matic process," says Perry.

Easier, continuous welding at faster speeds; quicker set up time per job; simpler wire change over and longer wearing alloy deposits have increased the efficiency of Westlake's entire operation.

A complete range of build-up and hard surfacing alloys packed in convenient 100 pound Payoffpaks provides longer wearing deposits for all hard surfacing requirements. The low initial cost of the Wear-O-Matic process makes the change over to semi-automatic hard surfacing feasible for every maintenance shop.

Your weldors will like the ease and convenience of the Wear-O-Matic process and you'll like the increased production. Write for Bulletin HS-102, Alloy Rods Company, P. O. Box 1828, York, Penna.

Alloy Rods Company

YORK, PENNSYLVANIA • EL SEGUNDO, CALIFORNIA

How Claude Phillips helped

More than ten years experience as a welding specialist gave Claude Phillips a sound basic knowledge of metallurgy and grinding methods. In the years since World War II, he has expanded that knowledge into an expert's familiarity with all types of grinding techniques. It is this wide yet concentrated experience that makes him so outstandingly useful to his customers.

cut stainless steel weld-grinding costs

There's nothing delicate about stainless steel until you overheat it. Then you've got a problem... because excessive heat breaks down the chemical structure of the metal and reduces its resistance to corrosion.

Nobody is more conscious of this than Plant Manager John Luker of Gaston County Dyeing Machine Co., Stanley, N. C., and the man who helped him solve the problem... Claude Phillips of Bay State distributor Southern Oxygen Company.

Knowing the job that Bay State Blue Flash R grade wheels had been doing for others, Phillips persuaded Luker and Purchasing Agent James Stroup to try them. They not only cut cool... comfortably below the 670°F critical limit of stainless... they gave him a higher rate of stock removal than any other wheel on the market. As a result, more work is produced per payroll dollar and there are neither hot spots nor weak spots in Gaston County Dyeing machines.

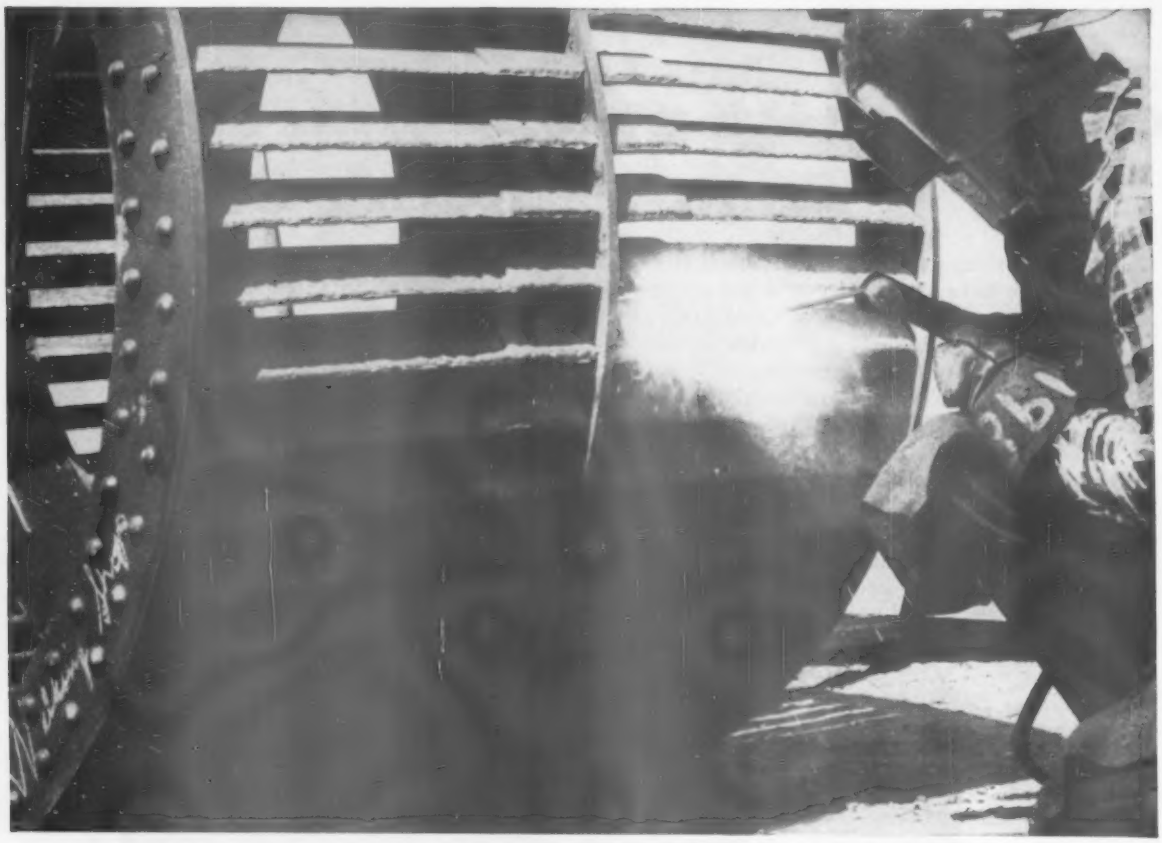
Like Claude Phillips, your own Bay State distributor is an experienced specialist in grinding problems. Cost-cutting ideas he develops for others may be unexpectedly useful to you, too. Why not get in touch with him and see what he can do? *Better grinding at lower cost—that is his business.*

Operator uses 9" x 1/8" Blue Flash R grade raised hub disc wheel to blend pressure tank of T-316 stainless. This wheel generates minimum heat yet gives extremely high rate of stock removal.

BAY STATE WHEELS of PROGRESS

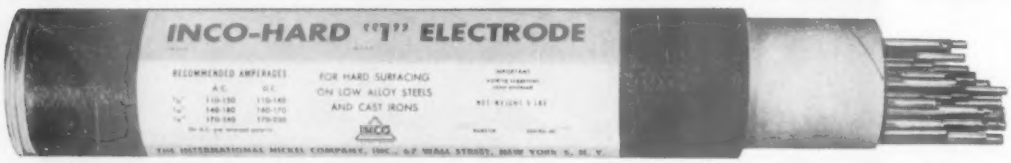
BAY STATE ABRASIVES

Bay State Abrasive Products Co., Westboro, Massachusetts.
In Canada: Bay State Abrasive Products Co., (Canada) Ltd., Brantford, Ontario.
Branch Offices: Bristol, Conn., Chicago, Cleveland, Detroit, Pittsburgh. *Distributors:* All principal cities.



Abrasion resistance to order. Weldor hard-surfacing 58" fan, using Inco-Hard "1" Electrode. Fan will handle 135,000 cfm of 200-300°F gases carrying highly abrasive dusts.

Such a hard surface at such a low cost...



This hard-facing electrode does it!

This weldor is hard-facing fan blades to 650 Brinell quickly, easily, and . . . economically. He's doing it with Inco-Hard "1"* Electrode.

Inco-Hard "1" puts the abrasion resistance where you need it . . . and only where you need it . . . on hard-duty parts such as baffle plates, crawler treads, scraper lips. Laid on cast iron, mild and low-alloy steels, a 1-layer deposit gives a 500 Brinell surface hardness; 2 layers give 600-700 Brinell.

Worn-down manganese steel parts, as well, may be built up with Inco-Hard "1" Electrode. A 3-layer deposit will give about 600 Brinell, provides good service life.

Inco-Hard "1" top value in hard-facing electrodes

Inco-Hard "1" Electrode gives you good hardness quickly and easily. You can use it in all positions. A.C. or D.C., you get a spray-type arc. And . . . a smooth bead contour which generally needs no grinding.

Complete data and suggested procedures for using Inco-Hard "1" Electrode are given in new 8-page data sheet . . . yours by writing Inco.

*Registered trademark

THE INTERNATIONAL NICKEL COMPANY, INC.

67 Wall Street — New York 5, N. Y.

INCO WELDING PRODUCTS

electrodes • wires • fluxes

BETWEEN PASSES

welded products month

The American Welding Society has crossed us up. Twice within the past several months, we reported that our "Remember September—National Welded Products Month" campaign has been changed to a "week." Now, we learn that the entire month of April has been set aside to give welding its due. Week or month, we are happy to see AWS getting behind this promotion. Originated by WELDING ENGINEER, National Welded Products Month should be publicized by all of us in the industry. The AWS naturally chose April rather than September so that the "month" would coincide with the welding show. This year's show will be held April 7-9 in Chicago. The annual spring meeting of AWS will run from April 6 to 10, along with an electric welding conference sponsored by AIEE.

So start now in promoting welding and National Welded Products Month.

boost for science

An army of business leaders and research scientists invaded the classrooms of Chicago's public high schools Jan. 16. Their purpose: to talk science to about 100,000 students. Believed to be the first of its kind, the event was the brainchild of Edward C. Logelin, Chicago vice president of U. S. Steel Corp., and Dr. Benjamin C. Willis, general superintendent of Chicago public schools. Forty-five of the city's 48 public high schools held student assemblies simultaneously. Each group of young men and women was addressed by a Chicago business leader who spoke on the importance of science in the world and the need to develop conscientious men and women to meet future responsibilities. Logelin and Willis developed the project to stimulate greater student interest in science and to give recognition to teachers.

The school speakers, who included several men from the metalworking and steel industries, were to be briefed at a special breakfast that morning by Dr. Wernher von Braun, the Army's top space expert, but his plane was grounded.

this issue . . .

Contains several articles on welded construction, encompassing buildings, bridges and radio telescopes. So it is all the more timely that we report here the prediction recently made by H. B. Dietrich, president of the American Institute of Steel Construction. Structural steel shipments are expected to reach 3,300,000 tons this year, he said. New orders would exceed 3,000,000 tons, as compared with about 2,800,000 tons in 1958.

recognition?

We don't know how those of you who saw it felt, but when we watched "Twentieth Century" on TV a few Sundays back, we got quite a thrill.

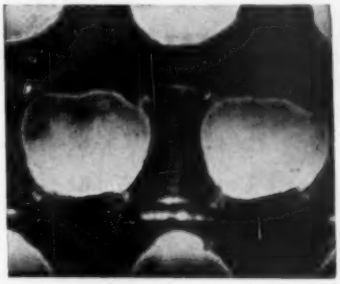
The program was devoted to the Remagen bridge, and the avenue across the Rhine it afforded to thousands of surprised but wary American troops. The German practice of demolishing Rhine bridges hung fire in this instance, and the crossing that was subsequently made played a large part in the collapse of the Third Reich.

But it wasn't just the crossing that held our attention; it was also the dramatic photos of weldors taking a hand in stabilizing the heavily-shelled span. Of course, as many of you know, the bridge tumbled suddenly about a week after crossings began, but this failure couldn't be attributed to welding. Without the men behind the masks, it's doubtful that the shaky structure would have lasted even a week.

This filmed episode is just one of several we've witnessed in the past year or so in which the weldor's arc (or flame) was given a few moments of richly-deserved attention; we have also noted an increasing use of weldor photos illustrating ads in many consumer magazines.

Maybe the welding films or photos were chosen simply because the sparks are dramatic; this is almost surely the case in most instances. But whatever the producer's motivation, he is showing the American public a pretty terrific metal-joining method. And, what's more, he's always showing it under highly favorable circumstances.

This type of good publicity—accidental or no—is right down our alley.



a lot smaller

On page 50 of the January issue of WELDING ENGINEER there appeared a reproduction of the fine-mesh screen being Tig welded by Airline Welding & Engineering, Hawthorne, Calif. The caption under the enlargement (above) stated it was ". . . really only ⅓ of a square inch of screen!" What it should have read was ". . . 1/130 of a square inch." The larger photo, reproduced in blue atop that page was about ⅓ of a square inch. Ah, those typographical gremlins.

the Bard

Shop condition: Welding aprons in short supply

. . . blistered breeches . . .
King Henry VIII, Act 1, Sc 3

...UNIONARC Welding saves $7000 on one production run

UNIONARC Welding—LINDE's new electric welding method for steel—increased production by 300% and saved a western pipe mill $7000 on a single run of steel pipe. Replacing covered electrode methods, UNIONARC Welding is expected to save this company $150,000 a year.

UNIONARC Welding uses a continuously-fed wire electrode, magnetically coated with flux and shielded with carbon dioxide gas. It has three times the speed and weld penetration of covered electrode welding. And UNIONARC Welding gives you "finished", X-ray quality welds and low hydrogen deposits—in all welding positions.

See for yourself—ask your nearest LINDE representative to *prove* that UNIONARC Welding slashes time and labor costs over conventional methods. Call your local LINDE office today! Or write Dept. WE-2. LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. Offices in other principal cities. In Canada: Linde Company, Division of Union Carbide Canada Limited.

Linde TRADE-MARK

UNION CARBIDE

"Linde", "Unionarc", and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

FEBRUARY, 1959

Welding Engineer

ESTABLISHED 1916

Once again—*rules!*

THERE WAS A FIRE in the high school in our town recently. It was a fire blamed on an "acetylene torch."

We can thank God it wasn't serious—just stupid! As stupid, in fact, as all the other fires that have been attributed to the "acetylene torch" when, actually, they should have been blamed on poor management and supervision.

Naturally, personnel at the top won't admit they're doing a bum job. But when they allow employees to store oil mops under a flame-cutting table—as someone did in the high school—there is laxity of the first order.

To "correct" the high school situation, a fire chief stated to newsmen that "they are going to have to build a welding chamber" (whatever that is). Here is reasoning to make you blink: instead of storing oil mops in a safe place, the school may build a *welding chamber.* We cannot help but wonder if oil mops will be brought into this new chamber and stored once again in their old place—under the cutting table.

This is the type of incident that fairly shouts for attention—on your part, as well as ours. Only a few rules are necessary to make welding and cutting operations safe. It seems time to impress them once again upon users of these processes. They are:

1. Never flame-cut or weld where sparks or flame could be hazardous.

2. Before cutting or welding in a new area, check on possible fire hazards.

3. When flame-cutting, move combustible material *at least* 30 ft from the torch.

4. Use sheet-metal guards, asbestos, or *any fireproof material* to keep sparks in the immediate work area. Don't use tarpaulins!

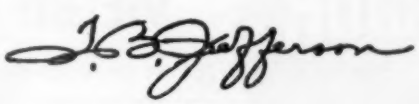
5. Sweep floors (and wet wooden floors) before lighting a torch.

6. Protect oxygen and acetylene hoses from possible damage.

7. Don't weld or cut tanks that have held gasoline or other flammable liquids without first *determining* and *taking* all necessary precautions.

8. Be prepared to stop a fire promptly. Keep extinguishers, water hoses or pails of water and sand ready for immediate service.

Please follow these rules. *You* can help make 1959 a year without fires started by an "acetylene torch."



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IN THIS ISSUE:
CONSTRUCTION

TOP: Wide-flange beams of varying size are welded manually to form double-X framework of lower pedestal carriage.

ABOVE: Brace columns for lower pedestal are checked for alignment before welding at Allison Steel Mfg. Co. yards.

BELOW: Lower pedestal carriage arrives at job site with some cone plates fitted and tacked. At this stage, it is already mounted on rails *(foreground.)*

Thousands of precision welds for a sensitive giant

THE SECOND of a pair of giant radio telescopes—largest in the U. S. west of the Mississippi River—is nearing completion in the Owens Valley desert south of Bishop, Calif.

Credit for the success of this million-dollar project goes in large measure to the precision work of a team of specially-qualified weldors, and to millwrights who performed many super-fine machining tasks.

Each of the radio telescopes weighs almost 175 tons. The "dish" antennae, which are 90 ft in diameter, are mounted on 32-ft tubes supported by conically-shaped pedestals 45 ft high. Of these major components, only the dish is fabricated entirely at the job site. The support tube, pedestal and base for the radio telescope now nearing completion were largely shop-welded by the general contractor, Allison Steel Mfg. Co. of Phoenix.

In charge of erection at the job site is Amercon Corp. of Los Angeles, whose project engineer, Lester M. Tint, describes some field assembly and erection procedures as "very unusual".

Basically, the factors that make these operations unusual are the size and weight of components, plus the need for extremely

LEFT: Age-old problem of fit-up momentarily halts welding of wide-flange beams in lower pedestal carriage as engineers analyze situation.

RIGHT: Weldor tackles job of joining four steel mill blooms to form 19-ton counterweight for Owens Valley radio telescope. Steel and plates have already been welded into place with E6010 electrodes.

close tolerances. But further complexities are added by the construction site itself.

Owens Valley, a good operational site because of the excellent protection against radio interference afforded by the Sierra Nevada and White Mountain ranges surrounding it, is constantly buffeted by high winds which can gust to 80 mph on occasion. Also, the ground water table lies just 5 ft beneath the surface.

To find the answers to as many potential problems as possible, the engineering staffs of Allison and Amercon met for months in advance of the project's starting date with representatives of the California Institute of Technology. This organization is in charge of the operation of the telescopes, the construction of which is being financed by the Navy Dept.'s Office of Naval Research.

The base for these radio telescopes is actually a carriage, for the completed structure is ultimately mounted on special railroad tracks which run for 1,600 ft in north-south and east-west lines on the valley floor. (Such an arrangement permits the units to get a better combined "fix" in measuring—by the principle of interference—the lengths of unknown light waves or the diameters of stars.)

Comprising the carriage are 21-in. wide-flange beams (68 lb/ft) of A7-53T steel. To these main beams are welded brace columns to support the lower pedestal. These are 18-in. WF beams. Joints between main beams and brace columns require ⅜-in., 45-deg fillet welds which are made with 3/16-in. E6010 and 6012 electrodes. Welding current is 170 or 200 amp.

The lower pedestal cone is ⅜-in. plate butt-welded with E6010 electrodes. To the cone are welded ½-in.-thick channel stiffeners. These latter welds are 7/16-in., 45-deg fillets, again made with 3/16-in. E6010's.

To join the upper pedestal skin to lower pedestal cone plates, Amercon's weldors used 3/16-in. E6012 electrodes and a welding current of 200 amp, d-c straight polarity. Following this operation, ½-in.-thick channel stiffeners were welded to the inside of the lower pedestal, and beams in the lower pedestal carriage were then tied-in.

Biggest of all welding jobs is the one which had to be done entirely at the job site: joining radial trusses and intermediate members to form the dish framework.

Forming the main structure of the dish are hot-rolled steel tubes with a 4-in. OD and 0.120-in. wall thickness. Special fixtures had to be made to hold these tubes for welding—and the welding sequence itself had to be carefully programmed—because the finished structure must be accurate within ⅛ in.

In view of the fact that the parabolic surface of the finished dish has an area of 6,400 sq ft, and that the expanded steel mesh which covers it cannot be out of line more than 1/16 in., the demands of this phase of the construction are obviously stringent.

To prevent any distortion through welding stresses, two teams of weldors started at the center of the dish and worked outward, always keeping the center point between them. By working in perfect unison as they deposited approximately 1,300 ft of ⅛-in. fillet welds on over 1,000 joints, these men met every tolerance requirement.

For the tubing welds, ⅛-in. E6010 electrodes were used at 110-115 amp. The 3½-in.-OD, schedule 80 pipe that served as intermediate members throughout the framework was welded with ⅛-in. E6010 electrodes at 110-115 amp wherever it joined the tubing. Pipe-to-pipe welds (normally at oblique angles) were made with 5/32-in. E6010's at 135-140 amp.

With welding completed on the dished antenna framework, the task to which much of the months-long planning sessions had been devoted was at hand. The antenna now had to be raised—without any shocks that might destroy its symmetry—to a height of 73 ft, and mounted on its supporting tube.

The lift was made—and without incident—by two 45-ton mobile cranes utilizing special holding equipment designed specifically for this job.

The brunt of the antenna's weight is ultimately borne, of course, by the pedestal and the base carriage. But the dish must have mobility for scanning, so it and the tube which supports it actually rest on four roller bearings.

These bearings, however, are something special: each is 32 in. in diameter and weighs 800 lb. They had to be installed in the field, and Project Engineer Tint indicates that this was a job of no mean proportions.

For one thing, all installation had to be performed by millwrights working 50 ft in the air on floats or platforms. Secondly, Amercon engineers had to design a special fixture utilizing a 200,000-lb hydraulic ram to drive the bearings home.

A third task successfully handled by the men in the field was that of shrinking the bearing shafts to ease the fitting problem. Dry ice packed around the shafts dropped the temperature of the metal almost to zero degrees Fahrenheit.

All the strength that welding can give is incorporated in the Owens Valley telescopes. But since they are unavoidably top heavy (an antenna weighs 40 tons), and since they must be mobile, the rails on which they ride are spaced 35 ft apart and are set in a reinforced concrete foundation.

The use of expanded steel mesh rather than a solid reflector surface is another important element contributing to the stability of these giant units. Rain—and particularly the high winds for which Owens Valley is noted—can pass freely through an area that might otherwise have made a perfect sail.

Five sets of reinforced caissons, each of which is set 17 ft in the ground, are set at intervals of 400 ft along the tracks. To these firm supports, the telescope carriages can be anchored whenever wind conditions rise to a danger point.

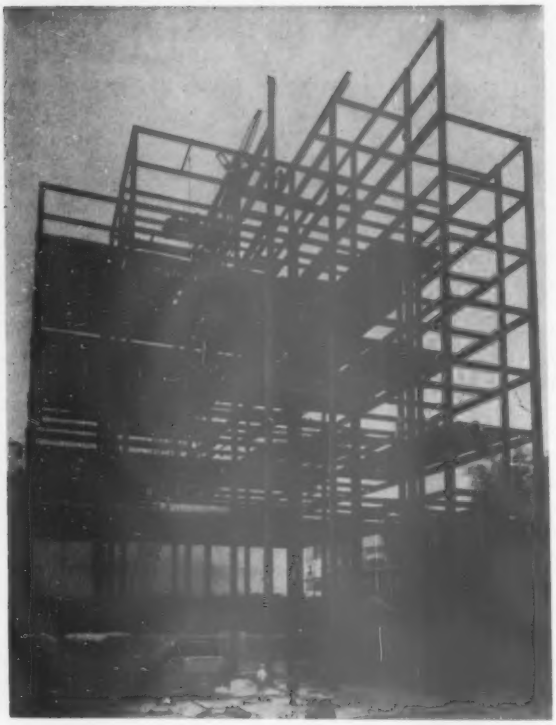
LEFT: Intricate welding demands are apparent in this view of pipe and tubing forming framework of dish antenna. Heavy castings at left and right are 7,000-lb declination hubs that receive shafts of drive gears which move antenna from horizontal to vertical position. Rotation (360 deg) is controlled at bottom of antenna support tube.

RIGHT: Completed antenna, with 6,400 sq ft of expanded steel mesh reflector material installed, is now ready to be hoisted 73 ft and mounted on supporting pedestal. Two 45-ton mobile cranes will handle job.

WELDS REPLACE BOLTS:

A change in plans cuts costs of new Denver building

by **Merrill F. Yale,** *District Engineer*
Lincoln Electric Co.



STEEL structure of Denver building went up quickly with design revised for welding. All welding was done in downhand position, principally with large-diameter E6024 and 6027 iron-powder electrodes.

SUBSTITUTION of new plans for old has resulted in the construction of Denver's first all-welded, multi-story building.

The seven-story structure is the new State Services building located across the street from the Colorado State Capitol building. It was erected by Burkhardt Steel Co., which originally received plans calling for the use of high-strength bolts.

Burkhardt requested permission to submit new plans for connections and splices—plans that indicated a full substitution of welds for bolts. State authorities approved the new plans—a fortunate move, for the steel fabricator proceeded to reduce material costs 2.5% and shop labor costs 19.3%. In addition, Burkhardt completed erection 12 days ahead of schedule.

Here's how these savings were effected.

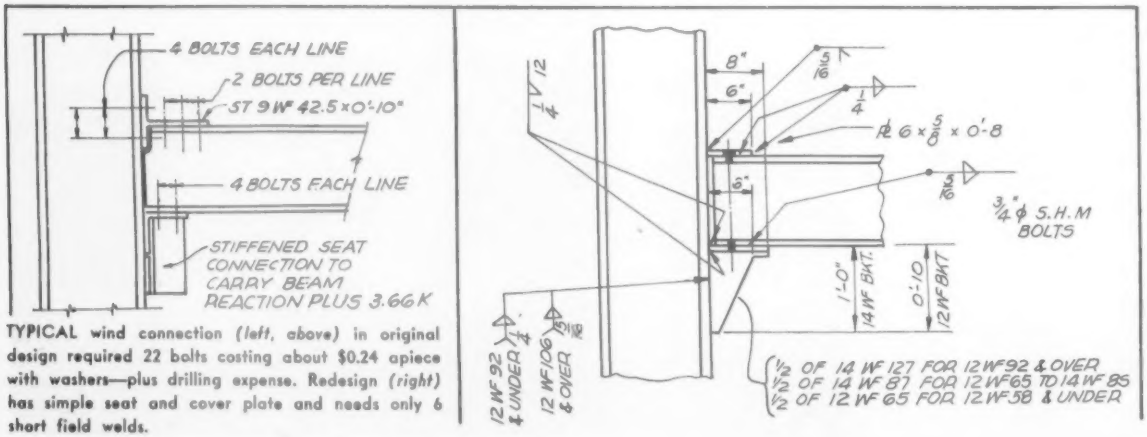
Design of wind connections for the new structure, as originally drawn, called for structural angle seats reinforced with plates to provide adequate strength to support the beam load. At the top of a beam, a tee-section was to be used for a cover plate.

The beam end was to be notched to accept one leg of the tee; the other two legs would be bolted to the beam and to the supporting column.

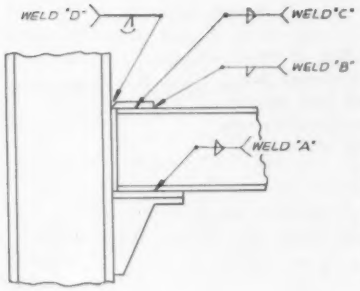
This type of connection obviously would have required several different parts, considerable cutting, and a lot of shop welding. In addition, the average connection would have needed 22 high-strength bolts costing about $0.24 apiece with washers, and each bolt would have necessitated the drilling of at least two holes.

The new connection design was, in comparison, amazingly uncomplicated.

A seat was half of an I-section, cut to resemble a tee-section with the web tapered back to the column like a shelf bracket. It was easily prepared and shop welded to columns. A cover plate, welded into place during erection, was 5/8-in.-thick bar stock with one edge beveled.

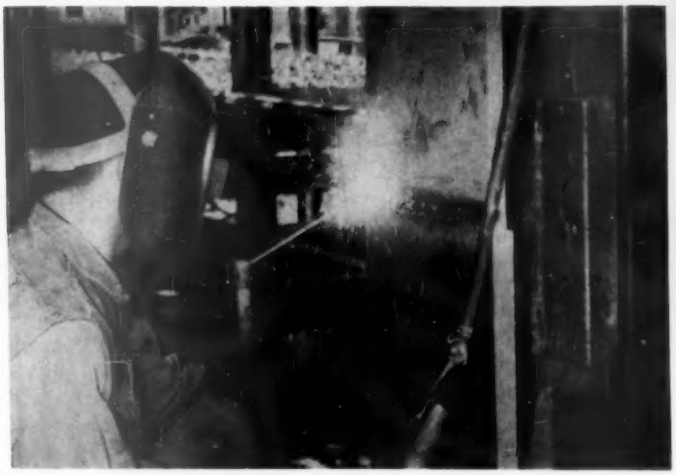

4 BOLTS EACH LINE
2 BOLTS PER LINE
ST 9 WF 42.5 x 0'-10"
4 BOLTS EACH LINE
STIFFENED SEAT CONNECTION TO CARRY BEAM REACTION PLUS 3.66 K
8"
6"
5"
PL 6 x 5/8 x 0'-8
3/4" ϕ S.H.M BOLTS
1'-0" 14 WF BAT.
0'-10" 12 WF BAT.
12 WF 92 & UNDER
12 WF 106 & OVER
1/2 OF 14 WF 127 FOR 12 WF 92 & OVER
1/2 OF 14 WF 87 FOR 12 WF 65 TO 14 WF 85
1/2 OF 12 WF 65 FOR 12 WF 58 & UNDER

TYPICAL wind connection *(left, above)* in original design required 22 bolts costing about $0.24 apiece with washers—plus drilling expense. Redesign *(right)* has simple seat and cover plate and needs only 6 short field welds.



SEQUENCE followed in welding connections: welds A, B and C are fillets made in that order with E6204 electrodes; weld D is last, and only weld requiring different electrodes. Two root passes were made with E6010 type and E6027 iron-powder electrode finished joint. Welder in photo at right is working with E6024, depositing ¼-in. or 5/16-in. fillets in one pass, depending on material thickness.

COLUMN splice is aligned and held for welding by tee-section and erection bolts. Upper column is beveled 45 deg from outside of each flange, leaving ¼-in. land. Bolts are removed after welding.



WELDOR makes column splice with E6010 electrode, welding on beveled side only. Welding in horizontal position is relatively easy in this instance because thicker lower column provides shelf to support molten metal. Redesign of splice for welding eliminated bolts, washers, spacers, cover plates and approximately 64 drilled holes.

The new design, in addition to simplifying shop work, also helped the erection crew. To make a wind connection, the crew swung a beam into place and held it with erection bolts until it was welded.

When welding began, it followed this sequence:

1—The first beads were deposited on either side of the beam, joining it to the seat.

2—With initial beads complete, a cover plate was placed on the beam, its beveled edge butted against the column.

3—A weldor joined cover plate to beam, starting first at the edge farthest from the column, then welding the sides.

All welds on these joints were fillets, and their leg size was ¼ in. or 5/16 in., depending on material thickness. The welds were made with E6024 iron-powder electrodes.

The first two passes of the final weld joining cover plate to column were made with E6010 electrodes. Iron-powder E6027's then were used to fill the rest of the groove and build up a fillet.

All welding was in the downhand position, most of it with iron-powder electrodes. Introduction of these high-deposition types to the field of structural erection, incidentally, is a major deviation from standard procedures.

Also simplified by the new design were column splices. Original plans called for cover plates on both flanges with spacers to equalize the size of upper and lower column sections. A typical splice would have required 32 bolts, and faces of column sections would have been milled to provide a close fit.

Welding completely eliminated cover plates, spacers, bolts and drilled holes. Outside edges of upper column section flanges were beveled. The chamfer was 45 deg, leaving ¼ in. of land.

Splices were welded from the outside, filling the groove created by the bevel. All welding was done with E6010 electrodes in the horizontal position, with the top face of the lower column providing a shelf that held weld metal and made welding easier.

BEING lowered into position at the nuclear reactor site in Dounreay, Scotland, is a 30-ton stainless steel reactor vessel. Many metallurgical problems were encountered when welding this reactor.

Part 3—Metallurgical problems

by **W. D. Biggs**
Murex Welding Processes Ltd.

A guide to nuclear power

A NUCLEAR REACTOR may be considered as part of a larger chemical plant, having the conventional problems of design, operation, materials, construction and maintenance.

In this third article in a series, certain aspects of nuclear power plant construction and operation (in relation to properties of the conventional mild, alloy and stainless steels used) will be considered.

Both the normal and neutron-irradiated mechanical properties of the materials must be considered when formulating the design of nuclear reactors. Selection of the most satisfactory material may depend as much on its neutron-capture characteristics as its tensile strength.

In general, reactor materials should be detailed by the design engineer —and changes from his specifications, or substitution of alternate materials, should be examined carefully before approval is given for such a step.

One of the most important requirements of any chemical plant is reliability. This is especially true of power plants since an extended shutdown for repairs or maintenance is expensive and may throw an excessive load on other plant units as well.

In some branches of engineering, as much has been learned from failures as from successes, *e.g.*, more has been learned from bridges which have collapsed than from those which have remained standing. However, development of nuclear power obviously cannot progress on this basis of learn-from-failure. Apart from damage by radioactive materials to any local inhabitants and/or their land, the psychological reaction to a major failure would probably de-

lay further nuclear power development for more than a generation.

A second consideration against such means of progress is the impossibility of conducting major modifications or repairs on a reactor unit once it is operating. Because of these disadvantages, design, materials and workmanship must necessarily be of highest quality and must be checked by stringent inspection procedures.

In the construction of reactors, a primary difficulty is the physical size of the shells. Present trends favor increased plate thicknesses in order to obtain more power output (3- and 4-in.-thick plates are now in use on many reactor shells) and these thicknesses will probably increase still further as operating demands are raised. However, this trend also contains many disadvantages.

The most significant effect of thicker mild and low-alloy steel plates is an increased tendency for brittle fracture. The raising of transition temperature (from ductile to brittle failure) by as much as 50 C (122 F) has been reported. Although good notch-toughness can be produced by suitable manufacturing techniques, these steels generally show a lower resistance to creep at moderately elevated temperataures.

(Another disadvantage to be considered is that efficient radiographic weld inspection with present on-site equipment becomes more difficult as thicknesses increase.)

Thus, materials to be used must offer a compromise between these opposing requirements of good notch-toughness and high creep-resistance. Development of steels possessing both requirements seems inevitable—but these properties must not be obtained at a sacrifice of the weldability of the steel.

Brittle fracture in structures can normally be traced to a notch-like defect which creates triaxial stress conditions restricting plastic flow of the material. Rigorous radiographic examination of welds on the reactor shell should prevent the presence of these defects. Microscopic defects, however,—such as fissuring and cold cracking of weld metal—would not be as readily detected.

On thick plate especially, these potential notches are accentuated by rapid cooling rates. Use of satisfactory welding electrodes and techniques (*e.g.*, special low-hydrogen electrodes with suitable preheating) can best eliminate these defects.

Avoidance of notches is, however, no more important than avoidance of high stress concentration in the material. Not only is it essential to reduce residual stresses by suitable welding techniques, but whenever possible, a stress-relieving heat-treatment should be conducted after completion of welding.

In gas-cooled reactors (which form the major part of Britain's present nuclear energy program) the average core temperature is comparatively low—around 752 to 932 F with an exit gas temperature of about 626 F. This is considerably lower than the gas temperature (932-1,022 F) in a conventional coal-fired power station. Therefore, the reactor's heat exchange mechanism must operate at a very high efficiency to extract as much heat as possible.

Although mild and low-alloy steels are satisfactory for present operating temperatures, future development will probably see wider use of stainless and heat-resisting steels in the coolant gas circuit.

Extensive testing has indicated that stainless steels of the stabilized 18 Cr/8 Ni type are the most convenient materials for these circuits since they resist attack by coolant gas and have a satisfactory resistance to deformation at the moderately high temperature involved. Stainless is also currently used in liquid-metal cooled reactors, although recent research indicates it may ultimately be replaced by titanium or zirconium.

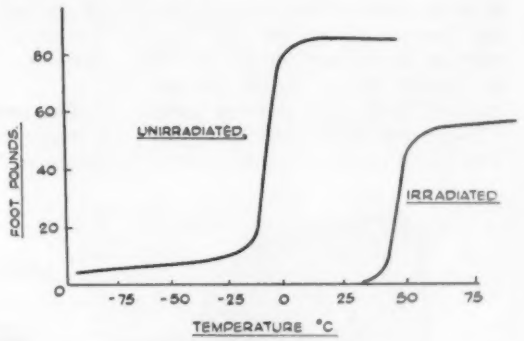
[Materials presently being used in U. S.-built reactors for ductwork, piping systems and mechanisms include the following: zirconium in water system reactors; aluminum in low temperature systems; ceramics in extremely high temperature applications; and stainless steel in systems where higher absorption cross sections can be tolerated.—*Ed.*]

In either gas or liquid-metal cooled reactors, welds must be of the highest standard to guard against leakage. (This could develop into a serious matter, especially in the primary heat exchangers where the coolant is radioactive.)

Pumping speeds must be extremely high (about 10,000 tons per hour) in order to obtain maximum efficiency of the coolant. At these speeds high standards of internal weld finish are essential because any projecting weld metal at the inside joint root would seriously impair flow and might also create an undesirable turbulance in the gas stream.

At present, official British publications do not give full details on specific materials used in reactor fabrication, and it is only possible to indicate the probable range of compositions from consideration of material properties under various conditions of temperature, environment and neutron flux.

Because of this limited amount of data, the statements below are obtained largely from a consideration of practice in the U. S. It must also be noted that a much wider range of stainless (data below deals with thicknesses ranging from 1½ to 3 in.) may be applicable when the steam-raising and power station plants



EFFECT of neutron irradiation on energy absorbed in notch impact tests of mild steel.

are considered. In these sections, conventional steam turbine practice will normally be followed, and it is possible that some of the more complex heat and creep resisting steel may be used.

Water cooled reactors—Stainless is currently being used as a container for high-purity water since austenitic alloys are superior to martensitic or ferritic alloys for temperatures up to 212 F. At 482 to 572 F the slight tarnish which develops does not materially affect the mechanical properties, but might result in build-up of a film which would seriously impair flow and heat-transfer characteristics.

For operation in the steam generating side of the reactor (or for boiling water reactors) 25 Cr/20 Ni/2 W and the 19 Cr/13 Ni types exhibit less corrosion than 18 Cr/8 Ni type alloys.

Gas-cooled reactors—There is little advantage in using stainless in this type reactor due to its undesirable neutron-capture characteristics. (This is apart from economic considerations.) Stainless is also unlikely to be employed for external ducting because of expense—but there may be limited applications for the 25 Cr/20 Ni, 15 Cr/35 Ni and straight 25 Cr grade stainless steels.

For certain applications cobalt has been found to improve corrosion resistance of some stainless steels, but cannot be tolerated in or near the reactor because of its high neutron-capture characteristics.

Liquid-metal cooled reactors—Stainless is at present the most convenient metal for use with sodium and/or potassium, neutron-capture being unimportant in fast reactors of this type. Severe corrosion may occur if the coolant contains more than 0.02% oxygen—but this may be neutralized in certain cases by addition of calcium.

Preferred grades on the basis of present tests are 18 Cr/8 Ni, 25 Cr/20 Ni and 18 Cr/10 Ni, either unstabilized or stabilized with columbium or titanium.

Present requirements do not involve use of exotic construction materials for reactors. However, it is unlikely that this will be true of later stages in the power production program, especially if the trend toward high operating temperatures continues.

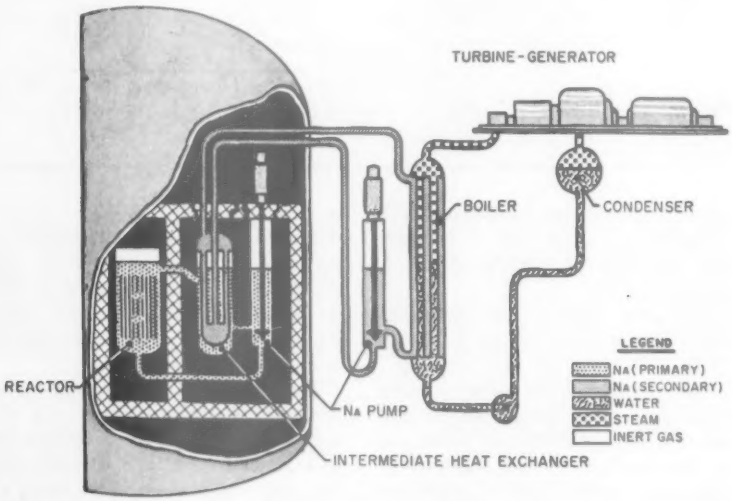
Assuming that the present reactor types do not change, use of other coolant gases for better heat transfer can be seen. In terms of availability, hydrogen would be a likely coolant, although the technical difficulties would be great.

The present trend also suggests a steady increase in pressure shell thicknesses, but in view of the limitations set by notch ductility, it is probable that more highly alloyed steels will be used, together with wider applications of stainless and heat-resisting steels.

Whatever the outcome, it is obvious that the next decade or so will present an increasing number of new problems—and it is certain that there will be no decrease in the number and scope of welding problems which must be met and overcome.

(In his fourth and final article of this series, the author will discuss thermonuclear fusion. Look for it in WELDING ENGINEER.)

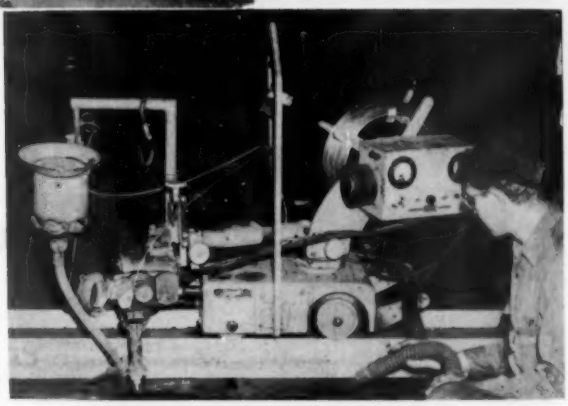
WELDED aluminum returns carry 12,000 gal per minute in the new "swimming pool" reactor at the Oak Ridge, Tenn., national laboratory. This is the first major use of aluminum for main coolant lines at a reactor.



SCHEMATIC diagram represents liquid metal and steam generation systems in the fast power-breeder reactor at the Enrico Fermi Atomic Power Plant, 30 miles southwest of Detroit on Lake Erie.

"Why didn't you tell me you were sensitive to molten metal around the ankles?"

DECK of the railroad bridge used ½-in.-thick low-alloy steel plate and required more than 4,000 ft of welds.



FLANGE splices for the California railroad bridge were welded at the Vinnell Steel Co. plant using the submerged-arc process.

Submerged-arc builds California's first railroad bridge

MORE THAN TWO MILES of submerged-arc welds were used in constructing California's first all-welded railroad bridge—second of its kind in the U. S.

(Another welded railroad bridge was recently completed by the New York Dept. of Public Works for a branch line of the Delaware & Hudson Railroad near Cherry Valley, N. Y. See: *Less cost and better appearances through welded bridges*, WELDING ENGINEER, July, 1958, p. 50.)

Built for Southwestern Portland Cement Co.'s Mojave Northern Railroad, the California bridge crosses a new state freeway at a 55-deg angle 40 miles north of San Bernadino.

Basically, the structure is a through-girder floor-beam type with a ballast deck carrying a single track. It is supported by concrete abutments and cylindrical piers.

An estimated weight-savings of about 20% was realized, according to Division of Highways engineers, by using welded instead of riveted design. Actual welding cost amounted to only 2.5% of total bridge cost.

Four 35-ton girders, each 10 ft high and 103 ft long, formed a basis for the overpass construction. Each girder was fabricated from standard A-373 steel plate by Vinnell Steel Co. and hauled to the bridge site on special trucks.

Two 5-ft-wide plates were welded together to obtain a 10-ft web height. Three of these sections, each 34 ft 4 in. long, were then welded end-to-end for the 103 ft length. (All welding was done by Linde Co.'s submerged-arc welding machines.)

Flanges of different plate thicknesses were used to form a natural taper. These were first tack-welded in position then welded to the web. The entire assembly was tilted to permit downhand fillet welds.

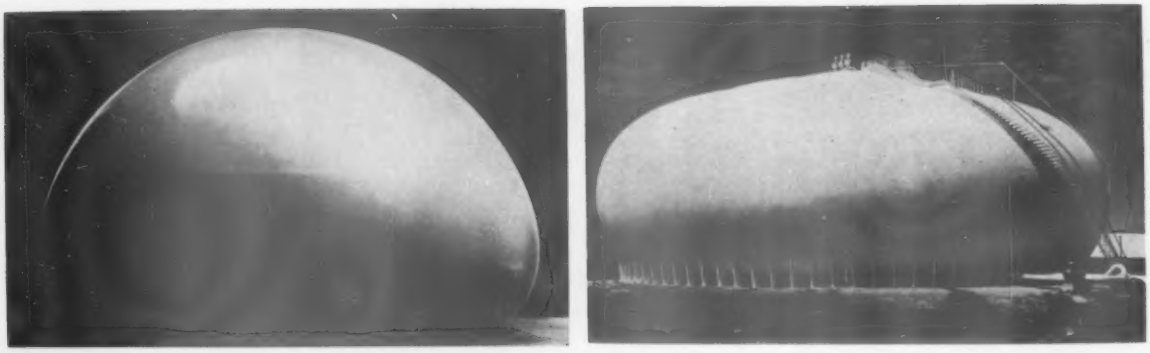
Welding current was a-c, ranging between 800 and 900 amp at 32 to 34 volts. A 3/16-in.-diameter mild steel wire was used and welding speed averaged 20 to 22 ipm.

Two stiffeners were added to the outside surface of each girder with a manually-guided, semiautomatic submerged-arc welder capable of joining long, straight seams.

These stiffeners reduced the required web thickness and contributed to general appearance. Vertical stiffeners, spaced 12 ft apart, were welded to the inside girder surface to give compression flanges greater rigidity.

All welding on girders and related parts was done at Vinnell Co.'s plant and required more than 6,000 ft of welds. The ½-in.-thick alloy steel deck plates, welded at the bridge site, required more than 4,000 ft of welds.

Previously, all California railroad bridges have been designed for riveting. Submerged-arc welding, however, is being used more and more in the state's bridge construction programs because of its speed, uniform weld quality and fully automatic operation.



DESIGN principle and finished vessel. At left, balloon partially filled with liquid assumes shape of mercury droplet, which holds shape due to surface tension. Completed Hortonspheroid at East St. Louis *(right)* derives its form from latter shape.

New storage vessel features thinner plate, improved capacity

by **Raymund V. McGrath**
General Engineering Dept.
Chicago Bridge & Iron Co.

CONTINUING ADVANCES in the design of pressure storage tanks for the petroleum industry are exemplified by three all-welded vessels recently erected by Chicago Bridge & Iron Co. for Phillips Petroleum Co.

Two of the 80,000-bbl noded Hortonspheroids are now storing highly volatile isopentanes under 10 psi pressure at Borger, Texas—site of one of the world's largest natural gasoline fractionating plants. The third unit provides 15-psi pressure storage for Phillips Pipe Line Co. at East St. Louis, Ill.

But if improved spheroidal design factors highlighted in the box accompanying this article seem readily apparent, the advances in spheroidal vessel construction in the field are even more obvious.

Erection procedure for a noded Hortonspheroid is, in many respects, unusual.

Before construction begins, an adequate foundation must be secured. Uniform support is necessary for bottom plates so that weight of the liquid load will be transmitted directly to the foundation.

At East St. Louis, a thorough soil study showed a 15-ft depth of silted sand that had to be removed and recompacted in 6-in. layers to obtain the required soil bearing.

The surface of such a compacted foundation may be left in a horizontal plane or shaped to approximate bottom plate curvature. In either case, a dry, free-flowing sand cushion is placed between the plates and the compacted soil to obtain uniform support. Grade stakes and curved boards shape sand to the required curvature.

Cribs positioned in concentric circles beneath the bottom node point and the outside girder support the steel bottom during erection. Bottom plate assemblies are positioned on these cribs and welded together.

For the manual metal-arc welding performed on all three vessels, E6010 electrodes were used on plate less than $\frac{3}{8}$ in. thick. Low-hydrogen E7018's were applied to all plate $\frac{3}{8}$ in. thick and more. Selenium-rectifier welding units were used on both job sites: at East St. Louis, they transmitted power from diesel generators, and at Borger, from power lines serving the Phillips installation.

With the bottom welded, its underside is painted and the weight of the steel is transferred from the cribs to jacks. The sand cushion is then carefully swept to fit the exact contour of the bottom, and the bottom tub is lowered to the sand. This is a planned sequence in which care is taken to keep the assembly level and to prevent rotation.

DESIGN FACTS:

"An ideal shape for storage of liquids under pressure"

CONCEIVED as an ideal shape for liquid storage under pressure, a Hortonspheroid derives its form from the shape of a drop of mercury resting on a flat surface. Its steel shell is comparable to the confining surface-tension "skin" of the droplet.

Because of variable storage conditions—*e.g.*: partial heights of liquid and pressure fluctuations—certain modifications in shape must naturally be made. The tank bottom, for example, is curved to resist internal pressure when the vessel is empty. Also, external brackets are used to support the overhanging liquid load.

Though the smooth spheroidal shape could theoretically store unlimited capac-

While the bottom is being constructed, pre-assembly of the upper plates and structural members progresses in adjacent areas. With the bottom on the grade, internal ties and upper circular girders are hung in place to form two concentric cages.

This internal framework is then capped with a roof plate, which is erected with the help of a tower in the center of the tank. Outer shell plates pre-assembled to shell trusses are installed, closing the gap between bottom and top nodes.

All seams in the three vessels were completely checked by magnetic-particle inspection after one side was welded and back-gouged. When welding was completed on both sides, radiographic spot checks were made along all seams.

This radiographic inspection indicated that weld metal quality in the noded Hortonspheroids is substantially higher than that found in previous vessels of this type. Such an increase in quality can be attributed, in large measure, to the adoption of low-hydrogen electrodes for field-welding such vessels, and to the elimination of backed-up joints.

CRIBS support bottom node of vessel during welding while outer bottom plates are placed on shaped surface of compacted foundation. Note welding machines at far right.

OUTER shell plates are pre-assembled to shell trusses before installation in gap between bottom and top nodes. Interior vertical supports are steel channels welded to form a tee and fixed in two concentric rings.

Final tests on each vessel followed this procedure, specifically developed for the noded Hortonspheroid:

First, low-pressure air was applied, and all seams above the high-capacity line were checked with a soapy-water solution. Pressure was then released and the vessel filled with water to the high-capacity line. With maximum liquid capacity in the vessel, a 25% overload pressure was applied with air.

(Two tapped holes at nozzles and manholes of each reinforcing plate facilitated testing. Welds on each fitting, and on bottom plate seams, were inspected by the magnetic-particle method before and after the over-load test to make certain that no defect had developed.)

Following over-loading, air pressure was reduced to working pressure to check the setting of relief valves. Vacuum vents were testing during the withdrawal of water. To check all stages of operation, working pressure was maintained above the water as it was withdrawn. A final visual and magnetic-particle inspection completed the test procedure, and the vessel was then painted.

ities, practical considerations (primarily, allowable soil bearing) have, until now, limited maximum capacity to about 40,000 to 50,000 bbls. The noded vessels built for Phillips were developed for larger capacities, and can produce a lower soil bearing than smooth vessels in comparable capacities.

The toroidal outer shell, with node points top and bottom, increases horizontal diameter and decreases the height of stored liquid. Internal trusses permit the use of thin shell plates during conditions of fluctuating liquid level and pressure.

The use of thin shell plates is particularly important if plates are to resist brittle fracture. Metallurgical authorities state that brittle fracture is not a factor in plates less than ½ in. thickness.

Despite their capacity, maximum shell-plate thickness of the Phillips vessels is only about ⅝ in. Average plate thickness for the 15-psi tank is about ½ in.; for the 10-psi vessels, it is approximately ⅜ in. Plate material in all cases is ASTM A201 Grade B—a fully-killed, firebox-quality steel.

Maximum diameter of the vessels is 127 ft, 6 in. Capacity is conservatively based on a bottom-capacity line at the adjacent grade line, and a 40-ft head range. Below grade, the tanks contain additional volume for 2,360 bbls. Above the top-capacity line, vapor space is equivalent to 5¾% of total liquid volume.

Of necessity, the design of certain vessel components is based on strain-gage studies. Stresses in statically indeterminate areas have been measured by experimental programs which have made improved details and minimized stress concentrations possible.

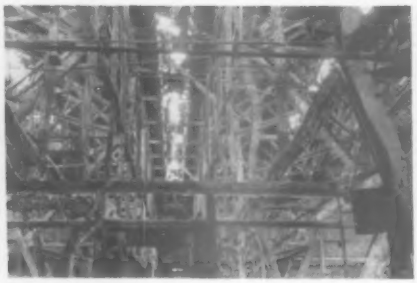
Design and construction of the vessels meets API standard 620 (a tentative specification covering large, low-pressure tanks in the ½ to 15-psi range), as well as the requirements of Phillips Petroleum Co. Plate thicknesses were calculated on the basis of a 15,000-psi allowable stress and 85% joint efficiency, as called for in the new API standard for the material used.

Improved details, coordinated with modern metal-forming and flame-cutting equipment, have resulted in a final vessel shape which agrees closely with theoretical design shape. In addition, residual stresses and distortion are minimized by furnace stress relief of shop-installed fittings, and by careful supervision of field welding procedure.

Welding Engineer *a special report*

AT McCHORD AFB:

Flame buckled this steel . . . and flame straightened it!



Twisted steel, smoldering aircraft, scorched walls: the calling-cards of disaster. Or near-distaster —for the steel structure of hangars 1 and 2 was to be left in place and re-shaped by the flames of oxyacetylene torches.

Part I . . .
the fire,
the damage survey,
and the beginnings
of one of the largest
flame-straightening projects
ever undertaken.

ON JANUARY 15, 1957, a guard stationed in an office in the huge combined structure known as hangars 1 and 2 at McChord Air Force Base saw flames licking at the fuselage of a C-118 aircraft. Leaving the room, the guard spotted sparks and smoke pouring from the upper section of a wooden structure housing a second-story coffee shop.

Returning to his office on the run, he turned in an alarm. The time was 5:30 a.m.

At approximately 7:15 a.m., firemen on the scene near Tacoma, Wash., brought under control a blaze that had gutted a large part of hangars 1 and 2. Asphalt covering the asbestos-protected metal roofing caught fire and dropped in flaming chunks on aircraft . . . into the paint shop . . . on piles of tires . . . and on magnesium wheels.

The combined hangar structure has a cubic content of approximately 11,000,000 cu ft, so average temperatures during the fire were relatively low. But wherever the materials listed above were afire, temperatures ranged to 1,200 F—and even to 1,900 F for a short time.

It was these high temperatures that caused what might have been the most costly damage to the hangars: deformation of many structural steel members. Wherever the fire burned hottest, steel beams became plastic and buckled.

The almost serpentine distortion of many steel members is indicated in photos illustrating this article. To some authorities at the scene, much of the structure looked ready for replacement. But dismantling wasn't in the cards, and for all but a handful of steel sections, replacement was totally unnecessary.

The answer — hinted at in conclusions drawn from a damage survey which found that the steel had not been heated to a temperature high enough to reduce its strength below permissible limits —

was flame-straightening. And the man designated as supervisor of the almost-miraculous torch work done at McChord was Joseph Holt, one of the nation's outstanding authorities on flame-straightening and a WELDING ENGINEER contributor.

(The principles and techniques employed by Mr. Holt on this and other jobs were those described in a booklet printed several years ago at his own cost and published by *WE* in 1955 as a two-part article: "Flame straightening: a friend in need" [Oct., p. 44; Dec., p. 30]. Some further comments by Mr. Holt on his remarkable repair method are presented with this article.)

Three repair methods actually were considered by government authorities before flame-straightening was given the nod.

One possibility has already been mentioned: a complete dismantling and complete rebuilding of the structural frame with new steel. But since only about 500 of the 1,900 tons of steel in the riveted structure were damaged—and since such work would cost roughly $1,200,000 — there seemed little sense in spending a great amount of money and wasting 1,400 tons of good steel into the bargain.

A second consideration was the dismantling of the frame, and replacement of only those members distorted by the fire. This would save the undamaged steel, of course, and it could be done in less time than the method cited above. But the cost, an estimated $750,000, was still thought to be too high.

These costly methods made flame-straightening seem desirable in many ways—and justifiably so:

1—it made dismantling unnecessary;

2—very few steel members had to be replaced;

3—the job could be done in the shortest possible time, and

4—most important of all, actual contract cost of flame-straightening *plus* the replacement of steel damaged beyond repair, was only $166,848—an average of just $112 per member straightened or replaced.

The engineering firm which had made the damage survey, Smith & Murray of Tacoma, was instrumental in the choice of flame-straightening, and was awarded a contract calling for its supervision of the repair work. Under terms of this contract, Smith & Murray was charged with the responsibility of securing the services of an authority on flame-straightening for general supervision of all such work. This stipulation led to the selection of Mr. Holt.

Named general contractor, with a bid of $464,592, was Roy T. Earley Co., also of Tacoma.

(In addition to the necessary steel straightening and replacement work, the Earley Co. bid included repairs on spalled or disintegrated concrete flooring; replacement of a large part of the V-beam roof covering, and of some corrugated cement asbestos siding; replacement of V-beam asbestos-protected metal siding, and of the copper-lined gutter between hangars; sandblasting and painting the structural steel; painting the siding, and reconditioning of main doors and tail-gate doors.)

Before flame-straightening was

What is flame-straightening?

Essentially, flame-straightening is a studied application of the simple fact that metal expands on heating and contracts on cooling. Using only an oxyacetylene torch, a flame-straightening expert can reshape steel parts that seem irreparably distorted.

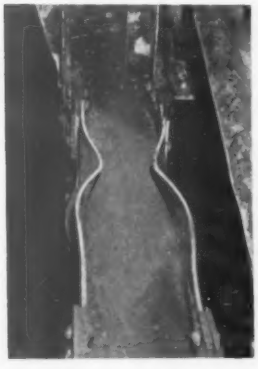
Joseph Holt, who supervised the straightening work at McChord AFB described on these pages, has this to say about the method he pioneered.

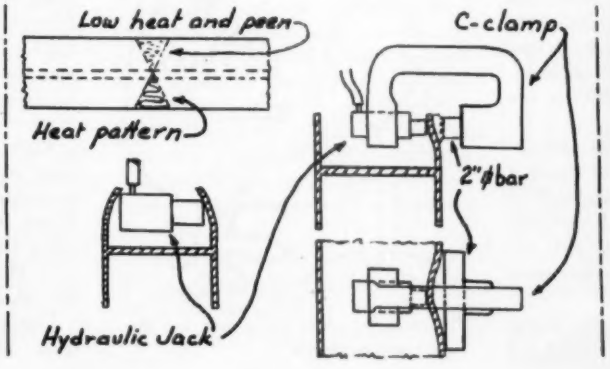
"Steel expands or contracts in a definite ratio to each degree of temperature change. A reasonably accurate scale allows for an expansion or contraction of ⅛ in. per foot of heated metal, if this metal receives the amount of heat necessary for a blacksmith's forge weld.

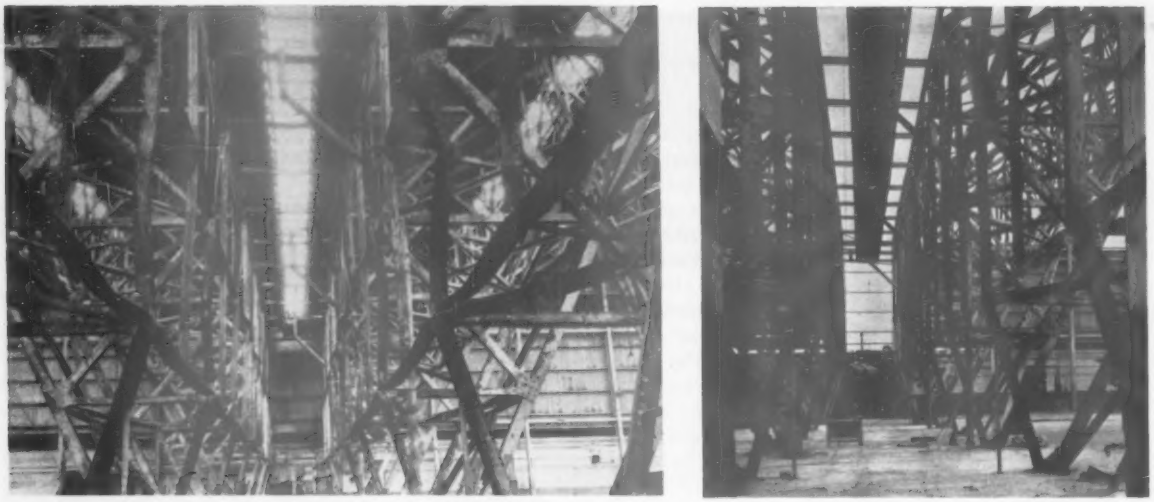
"The method of applying heat must be such that steel, instead of expanding in length, will expand *into itself*. To make this method work, there must be portions of the member cold enough, strong enough and so situated as to force 'inward' contraction where heated unless outside force can be added."

Unfortunately, though its principles can be explained and examples of its application can be cited, flame-straightening is not a "pat" subject for definition. It is literally an art, and is best used by men who have studied the effects achieved in a multitude of diverse applications.

BUCKLED flange of beam shown at left was heated and straightened in manner sketched in center until *(right)* it looks as though it had never been damaged.







NOT two different aisles, but the same one. Immediately after the fire *(left)*, the area at the juncture of hangars 1 and 2 seemed distorted beyond any hope of repair. That this assessment was in error is evident in the photo at right, taken a few months later after flame-straightening.

undertaken late in November, 1957, those in charge of the work naturally studied every aspect of the riveted structural steel frame in the hangars. Briefly, here is the manner in which this 19-year-old structure is designed:

Each hangar has 11 three-hinged trussed arches with a 275-ft span and a rise of 90 ft. Trusses are arranged in pairs, with their axes on a common center line. There is a 20-ft space between end pins of adjacent trusses, and a 5-ft space from outer end pins of the trusses to a brick curtain wall separating hangar area and shops. This makes an overall length of hangar floor of 580 ft.

Truss spacing between center lines is 25 ft. Since there are trusses at both walls, overall depth between front and rear walls is approximately 250 ft. All truss members have 10-in.-wide flanges, and are of varying weights.

At alternate panel points, trusses are connected with bracing trusses which also support 12-in., 25-lb (per foot) wide-flange beams parallel to, and halfway between, the trusses. Roof purlins are 8-in., 11½-lb channels spanning 12½ ft between the 12-in. beams and trusses.

Rear-wall framing consists of four-angle latticed columns, with channel girts above the brick curtain wall to which siding is attached. End-wall framing consists of channel girts attached to the back legs of arch trusses above the brick shop walls.

Front-wall framing above main doors consists of girts supported on hangers suspended from the arch trusses. These hangars also support the guide angles for rollers atop the main doors, and the canopy near the guide angles.

Fire damage to the structural steel, as reported in the preliminary survey by Smith & Murray, was most serious *(1)* in the center aisle between hangars where the wooden office and shop building burned; *(2)* in the northeast corner of hangar 2 where the rubber goods and fabric shop was located; *(3)* along the east wall of hangar 2 in the area of the tire shop, and *(4)* at the gable ends on east and west walls of both hangars where high temperatures were created as the asphalt protective coating caught fire.

"I was taking shots for a cold, but the boss found my bottle."

In the center section, practically all trusses and bracing members were distorted. Many roof purlins and beams sagged up to 3 in., and the horizontal bracing in the plane of the top chord was warped.

On the east- and west-wall gable ends, practically all girts had sagged. Two four-angle latticed columns on the east wall of hangar 2 were bent in both planes.

Though there was no complete truss collapse, a joint in the back leg of the south half of hangar 2's door truss failed when the rivets sheared. This failure let the truss collapse onto the center leaf of the main door. If it hadn't been for this "catch", both halves of the truss would undoubtedly have fallen to the ground, carrying other trusses in hangar 2 with them.

Arch trusses were the first structural members to be tackled by the five-man flame-straightening crew. Each of these structural iron workers was trained and qualified for the job by Joseph Holt, who also supervised every detail of their subsequent work.

Eight oxyacetylene heating outfits were moved to the job site for the straightening work, and two engine-driven welding machines were provided for necessary on-the-spot repair jobs. One unit was rated at 200 amp, the other at 250.

Distortion in the wide-flange arch truss members generally assumed

Lost: a chance for valuable study

"FLAME-STRAIGHTENING, as we have developed it during 40 years of careful research and application on damaged structures, has proved the most reliable and economical of all steel repair methods."

This is the considered opinion of a flame-straightening pioneer, Joseph Holt, whose work on hangars 1 and 2 at McChord Air Force Base certainly seems to prove his contention.

"Dollar savings are gained largely through *in-place* repairs," he continues. "Warped steel members needn't be dismantled: even during heating, *they carry their intended load.*

"These are the facts as we know them. But the engineering world demands proof through research.

"The fire-damaged McChord AFB hangars furnished an excellent subject for such study. Had a research team spent a few months on this job site, many lessons might have been learned at low cost.

"We tried to bring this about, but our efforts were fruitless. Now, with the job completed, any program aimed at evaluating flame-straightening for more general use will have to be set up at a university or private research laboratory. Costs for the program will be infinitely higher, and the work won't be done by men who have extensive experience with the heating method."

But the real tragedy, as Mr. Holt implies, doesn't lie in the field of costs alone. More important than dollars is the fact that thousands of influential persons in engineering will not receive research reports they must have to whet their interest in flame-straightening.

three forms: some were curved in a vertical plane between joints (and one of these exhibited horizontal distortion as well); flanges on others were buckled—usually inward toward the axis of the member—and on some, localized web buckling had occurred. Webs and flanges were most commonly deformed at points of maximum deviation from the original axis, and near joints.

In some areas, beam distortion had caused joints to rotate. To correct such a situation, torch operators had to combine their efforts and apply heat simultaneously to all the members common to the joint being straightened.

As an aid in re-aligning rotated joints, supplemental forces were applied to all compression (and most tension) members. Chain pulls, or struts and jacks, operating between a given member and the panel point of a truss opposite, prevented any further distortion during heating while helping to control straightening.

Individual straightening of all members common to a joint would have left the joint still in a rotated position. The resistance of other members to the effects of heat on one being straightened would cause this, and would also have resulted in a short bend in each member at the joint and consequent joint eccentricity.

Tolerances specified for straightening permitted a maximum deviation of no more than ½ in. for tension members, and ¼ in. for compression members. Actually, however, all members showed less than ¼ in. deviation after flame-straightening.

Low heat was applied to the buckled flanges and webs of arch trusses in straightening them. Additional force was applied to flanges by a short hydraulic jack inserted between them, and to the webs by a sledge. The heating pattern was one designed to prevent shortening of members along their axes, and consisted of a wedge shaped application in the flanges extending only to the web. Had a 90% depth pattern been employed, it would have upset a short length of the truss at the web—shortening the member upon contraction.

The object of low heat is to prevent upset of metal in a peened area, which would, in turn, offset the effect of upsetting in the heated area. Applying heat in the short-depth pattern allowed the concave edge of flanges opposite the heat pattern to be stretched by peening, which was done during contraction.

Upcoming in WELDING ENGINEER *is Part II in this coverage of one of the most extensive flame-straightening jobs in the country's history. Don't miss it!*

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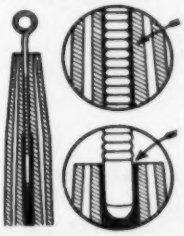

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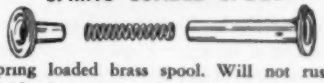

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17	57
18	56
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24	53-52
26	51-50-49
28	48-47
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A revolutionary welding method . . . just a noble experiment. . . These were some of the opinions voiced at Houston. What are yours?

New pipeline welding method makes U.S. debut

by **Ted Jefferson**

WILL THE "magnetic girdle" revolutionize pipeline welding?

This was the question most frequently voiced when Dr. Hans Gunther of Heidelberg recently displayed his pipe welding system to a select audience of oil company executives and pipeline contractors in Houston, Texas.

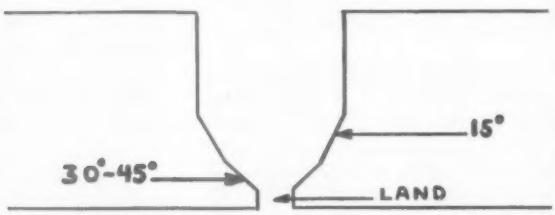
The demonstration, arranged by Earl Allen Construction Co. and Crutcher-Rothe-Cummings, Inc., resulted in a variety of opinions. Some were willing to bet all pipelines would be welded by this method within a few years; others saw it only as a noble experiment.

This automatic, electromagnetic welding system has been successfully applied in Europe. More than 20 miles of 8- and 12-in.-diameter steam and hot water lines with wall thicknesses ranging to ½-in. have been joined. The lines operate at pressures of 600 psi. Temperatures reach 392 F.

At first glance, the procedure resembles firecracker welding. Closer examination, however, reveals the arc controlled by an auxiliary electromagnetic field. A magnetic semi-circular clamping device, or belt—which the inventor terms "magnetic girdle"—serves to *(1)* hold the electrode in position, *(2)* control the arc, and *(3)* direct the flow of molten metal in the magnetic field.

Key to the welding system is the belt. In welding position, this "girdle" looks like a caterpillar gripping the pipe joint. Small copper links act as backups to hold the electrode in the

ELECTRODE is bent to circumference of a 12¾-in. pipe and placed in a specially prepared groove. Standard pipe-end bevels are re-cut to form deep U-groove *(see below)* with two bevel angles. Self-propelled tractor power unit *(in background)* provides welding current and power for girdle and auxiliary tools.



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MODEL EA-2 with current capacity of 300 amps holds 50′ of 2/0 welding cable. Model EA has capacity of 100′ cable.

MODEL A-1 has 50′ capacity of ¼″ or ⅜″ I.D. single hose. The larger Model A-2 holds 50′ of ½″ hose.

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bevel and assure a correct gap for the electromagnetic core's pole shoes.

The magnetic field is created by small, series-connected electromagnets held in place by mechanical linkage and protected by an outer spring wire guard. Mechanically, the belt is limited to 22 magnetic elements and only 12 to 17 have been used thus far.

This welding system demands special joint preparation, so standard pipe-end bevels are re-cut to form a deep U-groove with two bevel angles. The root has a conventional land. (See drawing.)

Above the land is a double bevel of 30 to 45 deg, creating a 60 to 90-deg included angle at this point. Above this are 15-deg bevels forming a 30-deg included angle for about one-third the thickness of the pipe wall. (This groove type apparently is common in Europe.)

WELDING time is about one minute per pass per belt. Note that welding is from a downhill position.

A specially designed pipeline clamp controls the root gap with a retractable feeler shim, so that a proper gap is provided for the first section of the stringer bead. (These shims work independently of the hydraulic jacks used to align pipe ends.)

Two German-made electrodes with special heavy coatings are used: a cellulosic coating for the root pass; rutile for filler and cover passes. Electrodes measure 4mm (0.156 in.) in diameter and 15 in. long.

Coatings must be ductile enough to permit bending the electrode to exact groove contour. They must also be good insulators to prevent arcing between the unused electrode and the pipe.

The bent or shaped electrode is placed either in the pipe groove, or, with large diameter pipes, is set in a holder contact in the belt prior to being snapped over the joint. In either case, there is direct pressure contact between electrode and current connection.

After the belt is attached and proper power setting determined, a weldor shorts the electrode to strike an arc. Welding then progresses automatically until the electrode is consumed. When the arc reaches the electrode end, the machine shuts off automatically, leaving only a fraction of unburned electrode.

When making a continuous weld, each electrode must overlap, and the resulting buildup must be ground before the next pass can be made. When a pass has been completed, flux is wire brushed from the weld. Each bead end is ground between passes and succeeding passes are staggered to prevent possible windowing.

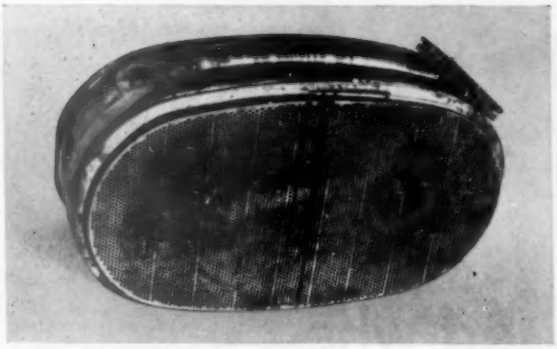
Pipe size determines the number of magnetic belts needed. On a 10-in. pipe, a single belt is used on each side. Two belts are used simultaneously on 12 to 16-in.-diameter pipe; three belts on 18 to 24-in.; and four on 26-in.-diameter pipe.

All welds are downhill: *e.g.*, on a 26-in.-diameter pipe, welds start at the 12 o'clock position and run downhill on each side to the 3 and 9 o'clock positions, and from there to the six.

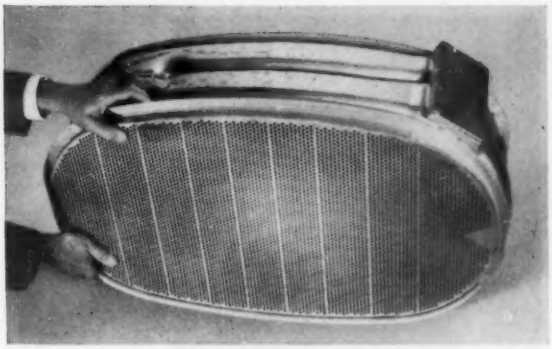
Actual welding time is about one minute per pass per belt. Current for the stringer bead ranges from 110 to 130 amp; for filler beads, 160 to 189 amp; and for the cover bead, 150 to 170 amp.

The equipment is flexible, and is capable of making multipass welds. It can be used for depositing filler and cap beads after the stringer pass is run by manual welding, or vice versa. Electrode diameter determines number of passes required.

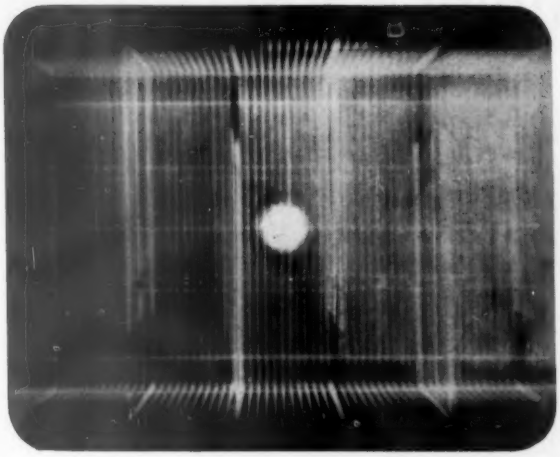
Welding current and field power for the magnetic girdle are obtained from a single-phase synchronous generator (15-kva, 400-volt, 100-cycle). Current is transformed to 100-volt, a-c open circuit, for welding.

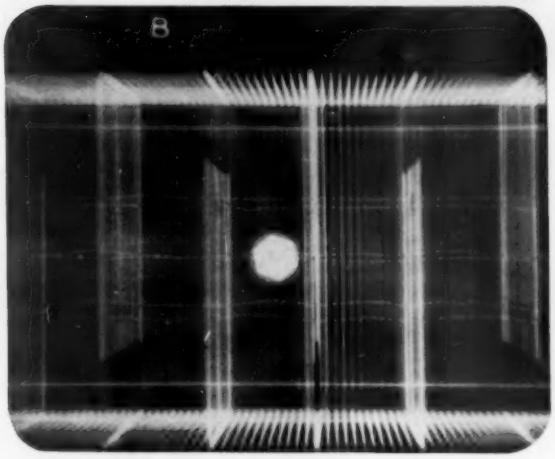


An oil cooler as it comes from the airplane engine. Radiograph below shows accumulations of sludge and dirt on the tubes.



After cleaning, the oil cooler is ready to return to its job. Radiograph below shows dirt gone and passages unrestricted.





To keep an engine's bloodstream clean

OIL COOLERS are vital to today's aircraft engines. At overhaul time they must go back on the engine clean as new. No minute particles of carbon or metal can remain to be a threat to the renewed engine. Cleaning them has become a specialty with SMS Instrument and Accessories Corp. of Idlewild Airport, N. Y. C.

To show that each cooler they clean is free of debris, it is sent to Industrial X-ray Incorporated, New Hyde Park, New York, to be radiographed. And when the cooler goes back to its job, its x-ray certificate of cleanliness goes with it.

In such inspections of assemblies, in quality control, in nondestructive testing, radiography provides a means of "seeing" internal conditions and also a lasting record of what is seen.

Producers of castings, and makers of welded products, find radiography a means of expanding their business and making sure only high-quality work is delivered.

Would you like to learn how it could help you? Contact your Kodak x-ray dealer or the Kodak Technical Representative to talk it over.

X-ray Division . . . EASTMAN KODAK COMPANY . . . Rochester 4, N. Y.

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TRADE MARK

WELDOR tack welds angles to diaphragm section.

Welding,

aluminum,

ancient principle . . .

All used when erecting Reynolds-Baroni bridge

PROTOTYPE of Reynolds-Baroni bridge. Hydraulic jack, used to place test loads on prototype, is shown over middle of bridge. Aluminum was chosen for construction material because of its lightweight, ease of shipment and few maintenance requirements.

THE PROTOTYPE of a newly designed welded aluminum bridge has successfully passed a test period, conducted at New York University, during which 70,000-lb loads were placed on the structure 20 times a minute. The tests simulated 100 years of normal commercial traffic conditions so it could be determined if the bridge could withstand them.

Testing, using 120 stress gages and other instruments, proved the bridge has a high strength-to-weight ratio. The bridge has supported weight more than 1½ times its design load.

The bridge's strength comes from use of the arch, an ancient architectural principle, which supports heavy loads with a minimum of structural deadweight.

Research on the bridge and its design was done by Dr. Giorgio Baroni, under the sponsorship of Reynolds Metals Co., Richmond, Va. Obvious advantages of welding and the obvious advantages of aluminum prompted combining the two when research began.

A Reynolds-Baroni bridge constructed in the future will be composed of modular units, each section consisting of parallel, 4-ft wide, parabolic arches stiffened by diaphragms placed side-by side. The prefabricated sections will be of a standard length determined by the size of the bridge to be built.

Through use of modular units a continuous roadbed of any desired length and multiple width can be erected. Bridge length between piers may be up to 100 ft. Units can be installed with any standard type abutment and piers, Reynolds says.

The lightweight units, weighing 10 lb per sq ft, reduce the size of the sub-structure needed. When erecting a bridge no falsework and little scaffolding will be required. Roadbed concrete can be poured directly on upper plate, eliminating most of the time-consuming job of building forms.

New York University's prototype consists of sections exact in size and design to those that will be used in construction of the first full-size Reynolds-Baroni bridge. This will be a 234-ft structure spanning Big Wills Creek in DeKalb County, Alabama.

The prototype weighs 6,800 lb; the contemplated Alabama bridge will weigh approximately 117,000 lb. This is said to be one-fourth the weight

EDGE weld being completed on arch section.

of a comparable bridge constructed with conventional materials and design.

Main structural joints on the prototype were Mig welded in one pass using a 5356 aluminum electrode, 3/64-in. diameter. The skin covering the arches was fabricated by welding aluminum sheet to an extrusion. Annealed 5083 aluminum sheet was used in the arches and most of the components.

Power source was a 350 amp a-c welder. Before welding, parts were degreased and wire brushed. No post-welding treatment was needed.

Upon completion of the simulated 100 years of traffic passage, no weld failures were detected.

Extensive testing at the University, under the direction of Dr. James Micholas, chairman of the Dept. of Civil Engineering, has proved aluminum and concrete can be used together. When aluminum is covered with concrete a stable, self-limiting oxide forms. It is said to provide better results than if no action occurred.

Tests also showed the bridge will withstand extreme heats, its strength not decreasing even if the bridge is heated to 300 F.

Testing was not intended to be of a laboratory type. The bridge sections were given no special protection when shipped from Reynolds' McCook, Ill., sheet mill. The prototype was erected outdoors, under ordinary field conditions, by regular construction crews.

Ampco-Trode 160 reclaimed this 3,000-pound board drop ram.

WHICH OVERLAY ELECTRODE FITS YOUR JOB BEST?

Guide to Ampco-Trode* Characteristics

AMPCO-TRODE 160

DEPOSIT: High strength and good ductility with average hardness of 160 Brinell. Excellent bearing characteristics — resists squashing-out.

APPLICATION: Overlaying bearing surfaces subject to normal wear and shock. Joining aluminum bronzes, ferrous or non-ferrous fabrications, and dissimilar metals.

AMPCO-TRODE 200

DEPOSIT: Average hardness of 200 Brinell. Highest strength-hardness-ductility ratio of the Ampco-Trode series. Excellent wear-resisting characteristics.

APPLICATION: Widely used for bearing overlays where extreme wear and high pressures are encountered.

AMPCO-TRODE 250

DEPOSIT: Higher yield strength and hardness (average 250 Brinell) than Ampco-Trode 200, with lower tensile strength and ductility typical of the aluminum bronzes.

APPLICATION: Extreme bearing applications where very high pressures are encountered operating against hardened steel surfaces.

AMPCO-TRODE 300

DEPOSIT: Highest yield strength and hardness (average 300 Brinell) of the Ampco-Trode series.

APPLICATION: Fabricating new, or rebuilding worn, ferrous dies used for forming or drawing stainless steels and other clean metals. Other severe-wear applications.

*Reg. U. S. Pat. Off.

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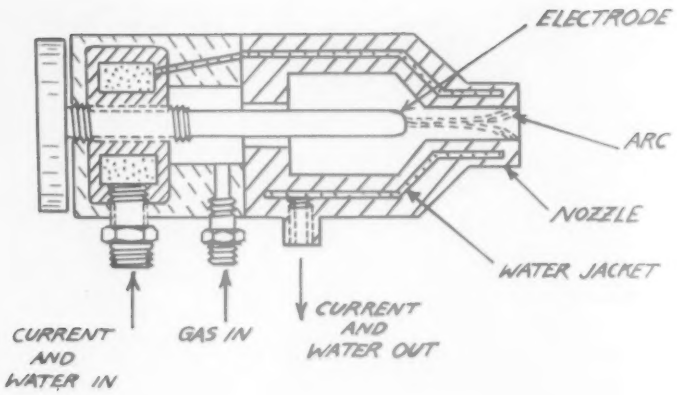


SKETCH of Plasma Flame torch shows arc formed at electrode end, and passing axially along nozzle passage to impinge against inner surface of passage walls.

Plasma heat—newest addition to welding's product lineup

How hot is 20,000 F? Hotter than a welding arc? Hotter than the sun?

The answer is *yes* to both — in spades! This temperature, and higher ones (up to 30,000 F) sustained recently with a new torch developed by Thermal Dynamics Corp. of Hanover, N. H., is more than double that of the sun's surface . . . over twice that of a welding arc.

This torch makes use of a plasma which, in this case, results from the electrical heating of a gas to such high temperatures that its molecules become ionized atoms containing high energy. (Physicists consider plasma a fourth state of matter, *i.e.*, neither gas, liquid nor solid.)

The plasma-forming gas (nitrogen, hydrogen, etc.) used in the Thermal Dynamics torch tends to cool the chamber-enclosed arc, producing a "thermal pinch." Arc current is restricted and resistance increases. The pressures and forces thus developed cause ejection of the plasma in a stream, or "plasma jet," at very high temperatures and speeds. To withstand the high temperatures, a water-cooled copper-alloy torch nozzle is used.

Electrical power for the Plasma Flame unit is developed from d-c welding generators, either engine-driven or rectifier types. Two 600-amp units power a 50-kw plasma torch, and voltage requirements are set by the gas being used.

What does all this mean to the welding industry? What can be done with it? First, all those things that could not be done with a chemical flame lacking sufficient heat.

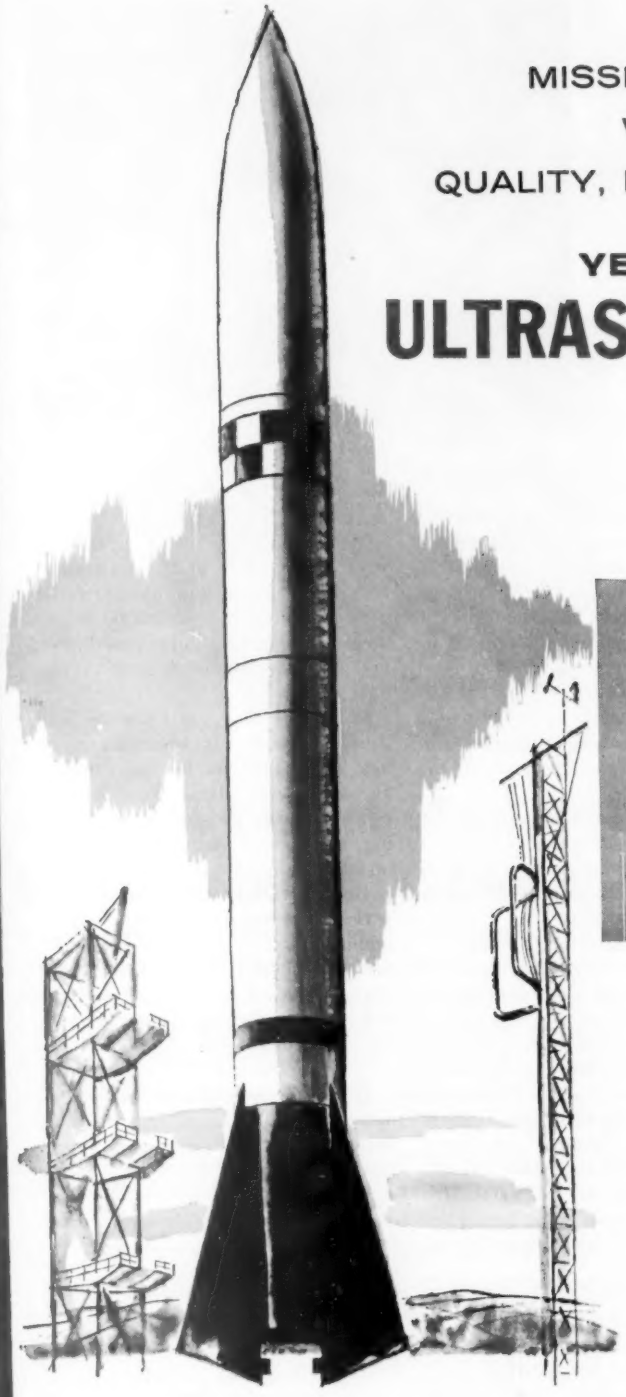
The peak temperature of any chemical flame is limited by dissociation reaction of the fuels. Dissociation absorbs energy which might otherwise be used to raise the temperature. When gas is heated by an arc, however, heat intensity is limited only by the amount of heat added to that gas.

Research in plasma flames has been going on for 20 years and high temperatures have been achieved at times — but only for a few seconds, not enough for experimental purposes.

Perhaps the first use of a plasma flame was represented by atomic-hydrogen welding. But in this case, arc and gas were not confined, so the temperatures created within the gas were not as high as they might have been.

At the present time this new process is being used experimentally in the

METALLIZING torch equipped with a powder-feed device is being used experimentally at present. Extremely refractory materials have been successfully sprayed.



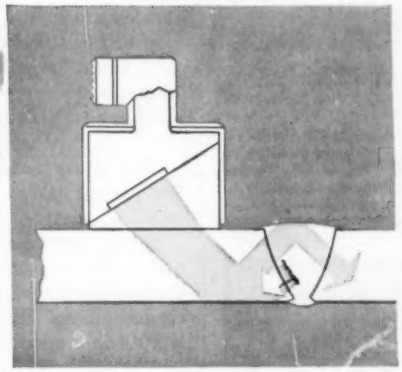
MISSILES DEMAND
WELDMENTS OF HIGHEST
QUALITY, REGARDLESS OF COST–

YET LOW-COST

ULTRASONIC TESTING

IS USED!

This is because Ultrasonic Testing can locate defects in welds that are hidden to other inspection methods.



Sound beamed at an angle into the plate passes through a good weld but is reflected back from a void.

WHERE COSTS COUNT MOST
SPERRY REFLECTOSCOPE

provides down-to-earth answers on weldment quality for every industry. The Reflectoscope locates cracks, lack of fusion, incomplete penetration, fatigue failure, even in the thickest plate and deepest welds. Costs are low. For example, in a recent test of seam welds on a large pressure vessel, Reflectoscope inspection was one quarter the cost of other testing methods. And, there is no radiation hazard.

FOR INFORMATION ABOUT THIS INSPECTION TOOL, FILL OUT AND MAIL THE COUPON.

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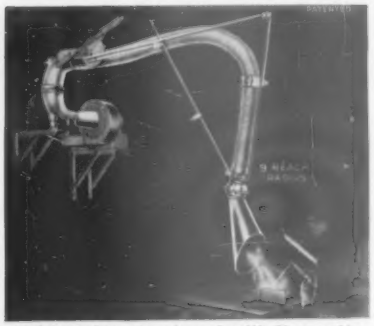
Remove Welding Fumes at the Source... with RUEMELIN FUME COLLECTOR



Welding shops equipped with Ruemelin Fume Collectors are assured of a clean shop atmosphere. Noxious fumes, heat and smoke are eliminated AT THEIR SOURCE. Improves working conditions . . . lessens fatigue . . . paves the way for increased plant production. Especially helpful in winter months when windows and doors are closed.

Note the new spring-loaded counterbalance mechanism which makes Fume Collectors much easier to handle.

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ANY Pipe Joint or Structural Angle Cut NOW Layed Out in Just MINUTES!

- Marks off easily and accurately any pipe joint.
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- Saves man-hours, as well as oxygen and acetylene gas.
- Makes it easy to mark off end of lateral pipe.

NO MISTAKES — NO TIME LOSS

—regardless of the type or size of pipe joint to be welded. No more "cut and try" with a **CONTOUR MARKER** — it eliminates the need for calculation, and is available in 2 sizes for marking pipe and structurals of 1½" to 18" in cross section, and from 16" to 48" diameter. Send for complete description.

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THE CONTOUR MARKER

PLASMA torch is also being used in gouging operations. High velocity of the jet stream removes the molten material which reached melting point on contact.

missile and rocket field. Missile reentry conditions can be simulated and processes involving temperatures capable of vaporizing all known substances are in progress. Ion propulsion of rocket vehicles in outer space is a future possibility, and is currently being investigated by several aeronautical firms.

But the greatest advances with the plasma jet *should* occur in the welding industry.

Several welding processes are now under development, and because of the high temperatures they produce, easier joining of hard-to-weld metals is a distinct possibility.

A metal-cutting torch, similar to a plasma torch, is now being used for high-speed cutting of non-ferrous metals and alloy steels. This device heats a stream of gas with an electric arc to high temperature. In the technical sense, however, this torch does not produce a plasma flame since it is not electrically neutral and cannot be maneuvered like an ordinary torch. (This is actually a transferred-arc torch. In the plasma flame torch, the arc is wholly contained, and is termed non-transferred.)

A form of metallizing also has been developed using the new process. Powder is contained within the plasma flame and projected at high velocity against a part being coated. High temperature permits continuous spraying of extremely refractory materials, *e.g.*, tungsten and high-melting-point oxides and carbides.

Another application is gouging. The steel being treated is brought to melting temperatures on contact with the plasma, and the high velocity of the jet stream removes the molten materials.

The plasma flame is capable of stream velocities and temperatures covering a wide range of values. Jet velocities of well over 20,000 ft per second are possible and are used when maximum heat-transfer rates are required.

By using lower gas pressures and subsequent diffusion, velocities can be held below 200 fps, less than that of an oxyacetylene flame. This low-momentum stream is used in fusion welding to prevent removal of molten metal.

Exit gas temperatures can be easily varied from less than 3,000 F to maximum values. By use of proper temperature control, heat-transfer rates ranging from below that of an oxy-fuel flame to that of an open electric arc can be obtained.

A cost comparison shows that operating cost of a plasma flame is approximately half that of an oxy-fuel flame — when compared on an equivalent heat content basis. Because of higher plasma flame temperatures, greater heat transfer efficiencies are realized. (In some cases, it is possible to substitute a plasma flame of lower heat content to gain the same heating effect provided by an oxy-fuel flame.)

Additional advantages of the plasma system include the use of economical and non-combustible gases, and the ease with which flame perimeters may be controlled.

Major disadvantages are its complexity and high initial cost. Current research efforts, however, should definitely lead to wider application in the welding field.

Low Temperature EUTECTIC WELDING ALLOYS

Plant, Research Laboratory and World Headquarters

HISTORY OF "EUTECTIC LOW TEMPERATURE WELDING ALLOYS"®

Surface alloying at low heat was first discovered by "Eutectic" in 1904 – used today in over 100,000 plants. "Eutectic" is the originator and sole manufacturer of "Eutectic Low Temperature Welding Alloys" for bonding metals at low heat, minimizing distortion, warping and stress.

EUTECTIC Welding News

PUBLISHED BY EUTECTIC WELDING ALLOYS CORPORATION, 40-40 172 STREET, FLUSHING 58, NEW YORK, N. Y.

CAST ALUMINUM GEAR HOUSING REBUILT IN JUST TWO HOURS!

A severe blow cracked this expensive aluminum gear case. The lengthy crack passed through the ribs of the case as well as the flange. Replacement with a new casting meant considerable expense, but the difficulties of welding aluminum satisfactorily seemed to rule out repair, until the local "Eutectic" Technical Representative was called in and recommended Eutectic's EutecTrode 2101 with "Frigid Arc" flux coating.

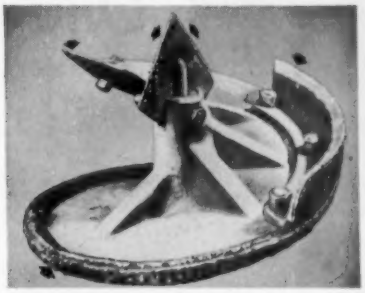
EutecTrode 2101, makes joints which are up to three times the strength obtained with conventional aluminum welding electrodes. Ultimate tensile strength—34,000 psi. Deposits are smooth, dense, non-porous and spatter-free. Arc is quick and easy to maintain. EutecTrode 2101 is non-fuming, has amazing arc stability with high corrosion resistance, good color match to aluminum.

This particular electrode is widely used for the production and maintenance welding of home appliances, chemical, food processing and refrigeration equipment. It is also used for decorative and protective railings, tanks, structural members, pipe, foundry patterns, truck, automotive and bus structures. Other applications include repairing cracks, filling holes, building up missing sections, cladding and reinforcing.

To prepare the gear case for the filling operation the crack was chamfered through its entire length. There was no porosity, no holes throughout the fill and build-up. To finish the job a sander was used to smooth the surface. The completed gear case had the appearance of a new replacement part.

Only two hours were needed to complete the repair of the cast aluminum gear housing, and return it to operation.

EUTECTRODE 680 AC-DC *inaugurates new auger life*



This farm auger was so badly worn it required complete rebuilding. The condition is common in farm tools used in abrasive soil. Because of widely varying soils, blades that give good service in one area can fail completely after a few acres in another. Today, maximum acreage service under all conditions is assured with regular use of EuteChrom overlays.

Best results with hard surfacing are attainable in many cases by first using a padding layer of EutecTrode 680 AC-DC. The padding base offsets any possibility of cracking during the welding operation, and in service, absorbs much of the impact shock. Thus, long life is insured with this hard overlay.

To repair this auger, a new steel strip was welded to the blade rim with patented EutecTrode 680 AC-DC. All wear surfaces were then overlayed with EutecTrode 12 AC-DC. This economical reconstruction gave the auger months more service life than even new equipment could provide.

EutecTrode 680 AC-DC, available in 3/32", 1/8", 5/32" & 3/16" dia. Lt. Blue Tip. • **EutecTrode 2101,** available in 1/8", 5/32", 3/16" & 1/4" dia. Orange Tip. Standard weight shipments.

FREE WELDING ADVISORY SERVICE AVAILABLE THROUGH YOUR LOCAL "EUTECTIC" TECHNICAL REPRESENTATIVE

A staff of technical welding experts are ready to consult with you. Write for help on any welding problem.

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EUTECTIC 'LOW TEMPERATURE WELDING ALLOYS'® FORMULATED FOR 'LOW HEAT INPUT' BONDING OF ALL METALS INCREASE SAVINGS BY SALVAGE AND REPAIR, SOLVE PRODUCTION PROBLEMS

CLOSEUP of one of 27 welds on main steam lead shows result of almost 2½ days work. Each weld takes approximately 3½ days to complete.

One weld:

160 passes,

3½ days,

$5,700

HOW MUCH IS $5,700? Compared to a construction budget of $200 million, not very much. But when this is the tab for *one weld*, it cannot be considered small.

Multiply by 27 welds, and you have the approximate cost of a modern boiler's 236-ton main steam lead currently being installed in electric power stations owned by Consolidated Edison Co. of New York, Inc.

The 160 passes needed to complete one weld (plate used is 3⅜-in.-thick chrome-moly), plus the slow annealing and cooling of the pipe's weld area, called for three and a half days of around-the-clock work for each weld. This included all work from preparatory stages to final weld finishing.

During the entire operation, low-frequency induction heaters are used to anneal the weld area and to maintain desired welding and cooling temperatures.

The first preparatory step is to wrap the pipe's weld area with asbestos paper, building it up to ¾ in. thick on each side of the seam. Asbestos-insulated cables, leading from the induction heater, are then wound around the 19½-in.-diameter pipe. Six turns on each side of the seam to be welded.

The weld zone is then preheated to 500-600 F, a temperature maintained for at least the first two passes. After root passes have been applied, weld-zone temperature is kept within a 400-900 F temperature range until the final stress relief operation.

The induction heaters record, as well as control, temperatures during welding. Two chrome-aluminum wires, attached to a thermocouple in the heater and to the pipe's weld area, transmit electrical impulses which are translated into readings on a temperature indicator and recorder.

The indicator shows present pipe temperature at the weld area, while the barograph-type recorder notes temperatures reached during welding.

First pass of the welding operation joins a backing ring to the bottom of the seam. The ring, of the same material as the pipe, prevents burrs and slag from collecting on the pipe's interior walls.

First bead of each pass is made with a ⅛-in. electrode, the rest with a 5/32 in. In both cases, a Metal & Thermit E9016-B3, high-strength, low-alloy, low-hydrogen rod is specified. (The electrode is rated at 110,000 psi tensile and 90,000 psi yield strength.) Power source is a 300-amp, d-c motor generator.

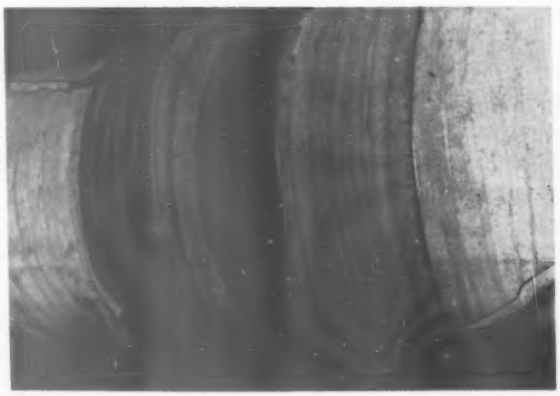
Each bead and pass is cleaned with an air-operated hammer and a wire brush. Radiographic inspections are made at the half-way mark, and at the weld's completion.

Wherever porosity is discovered, the weld is ground out and redone to prevent any possible breaks. Temperatures are kept between 400 and 900 F even during the necessary gouging and rewelding operations.

After the crowned joint surface is cleaned and ground smooth, the weld area is uniformly brought to 1,350 F to begin stress-relief. When this temperature is reached, the pipe is permitted to "soak" at a rate of two hours per inch of material thickness. This means almost seven hours of stress relieving.

To prevent the chrome-moly from becoming brittle, the pipe is not allowed to cool more than 350 F an hour until 600 F is reached. At this point, applied heat is removed and the joint is wrapped with suitable insulation to permit cooling to room temperature.

The main steam lead is hydrostatically tested at 3,800 psi. In operation, these pipes must withstand 2,200 psi of steam at 1,050 F. If the test shows no failures, the pipe is ready for an insurance company's inspection and full-scale operation.



WELD area shows asbestos-wrapped pipe, 12 turns of cable and half-completed weld. Small wires *(outlined at top left and lower right)* lead to temperature indicator and recorder.

new **ANDREX**
140 KV x-ray unit

doubles x-ray output

4 ma instead of usual 2 ma
quicksteps through
twice as much work per day

Costs no more than half-powered units —only $2300.

full-bodied power

4 ma... cuts exposure time in half

x-rays 1¼" steel in 45 seconds

fine detail: with 1.5 mm focal spot
compact: will pass through a 6" opening
lightweight: 50 lbs. easy one-man load
won't overheat: motor-circulated oil insulation with thermal safety cutoff

full dress control

with "big machine" range and certainty

full-size MA and KV meters
(not mere makeshift "penetration" or "reference" meters)

range 50 to 140 KV
range 1 to 4 MA
} both under continuous control
use *any* technic you want

direct operation off any power line
simply plug in on 110, 220, 380, 440, or 480 volt lines:
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fully weatherproofed
both head and control are gasket-sealed:
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Picker x-ray

For details on this unit or any of the other machines or services listed below call any Picker Branch Office (see local 'phone book) or write

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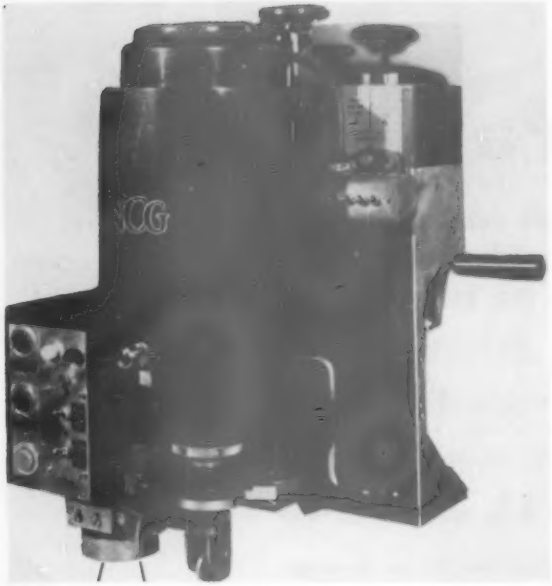
ANDREX	portable x-ray units—130 KV, 140 KV, 160 KV, 200 KV, 260 KV
PICKER	x-ray units—35 KV Beryllium window, 90 KV, 150 KV (stationary and mobile) 270 KV portable, intensified—image fluoroscopes
TECH / OPS	units for isotope radiography—sources, equipment, containers for Iridium ^{192} Cobalt ^{60} Thulium ^{170} and Cesium ^{137}
ACCESSORIES	. . . films, tanks, darkroom sundries illuminators, *everything*



CLOSEUP of electronic tracing head shows tracer control panel, drive wheel and gears. Line drawings, taped to metal sheet on tracing table, are scanned at 25 ipm.

—Greater flexibility

—Nesting freedom

—High accuracy

Electronic tracing —an additional cost saver for production flame-cutting

by **Leslie S. McPhee***

CUSTOM CONSTRUCTION . . . small production runs. Improperly handled, this type of situation could spell economic death for any manufacturer fabricating hundreds of different flame-cut parts.

At Whiting Corp. in Harvey, Ill., about three-fourths of all flame-cutting is short-run work, involving less than 25 identical pieces in a year. Much of the equipment manufactured by the company (for railways, foundries, chemical processing and material handling) is custom made and even standard designs are not produced in quantity.

Because of this production situation, the firm's welding department has always kept a weather-eye fixed on per-unit cost of flame-cut shapes — with particular attention to template or pattern costs.

Until recently, Whiting's cutting torches were guided either manually over line drawings or automatically on aluminum-strip templates. Last year, however, one of three flame-cutting machines in service was equipped with an electronic line tracer. Performance evaluation since installation: an almost 10% reduction in overall operating costs.

(The three flame-cutters, as well as the electronic tracing unit, are products of Chemetron Corp.'s National Cylinder Gas Div. The machines are in constant use cutting ⅛- to 12-in.-thick steel and alloy plate.)

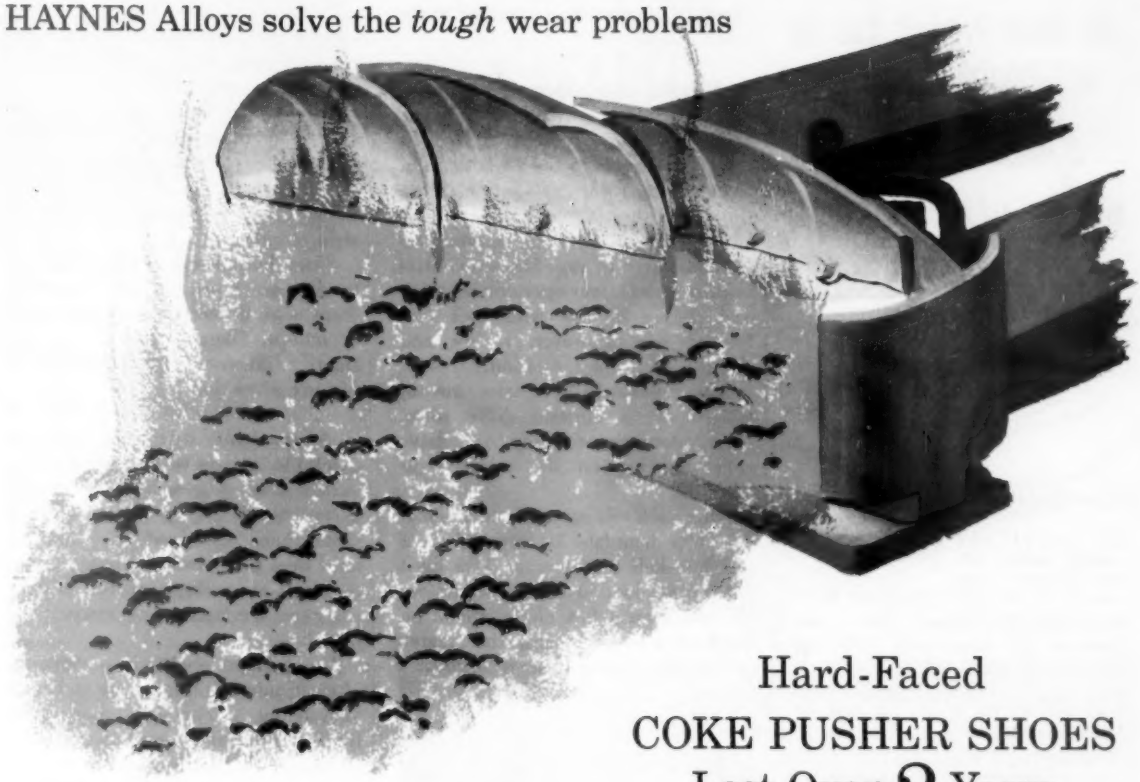
The optical scanning system of the tracer follows the exact center of any line 0.040 in. wide or less. The tracing head remains within 0.005 in. on either side of the scanned line at speeds up to 25 ipm.

Since the tracer will not follow a line intersecting its direction of motion at an angle greater than 45 deg, cutting torches can be made to cross their own paths automatically. Guide lines, smudges, finger marks and drawing sheet edges will not interrupt the tracing action.

A blueprint is first sent to the structural layout department where a tracing pattern is drawn. The drawing, allowing for kerf width, is then

* *Welding supervisor, Whiting Corp., Harvey, Ill.*

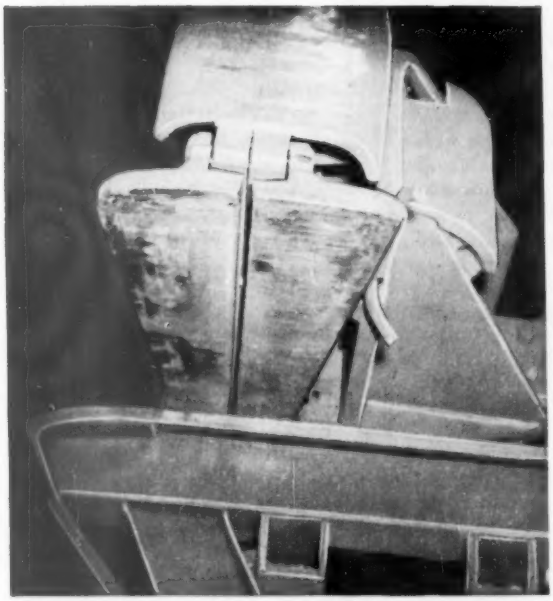
HAYNES Alloys solve the *tough* wear problems



Hard-Faced COKE PUSHER SHOES Last Over 2 Years

Resisting severe abrasion, heat, and thermal shock produced by riding over the coke-covered floor of 1800-deg. F. ovens—these shoes hard-faced with HAYNES STELLITE alloy No. 1 lasted over two years. Ordinary steel shoes wore out in two months.

Whatever your wear or abrasion problem, there is a HAYNES hard-facing alloy especially made to combat it. There are 18 HAYNES hard-facing alloys . . . a wide selection that assures economical protection from the most severe conditions of heat, corrosion, erosion, or wear. For the complete story write for descriptive literature or contact our nearest sales office. HAYNES STELLITE COMPANY, Division of Union Carbide Corporation, General Offices and Works, Kokomo, Indiana.



These shoes, hard-faced with HAYNES STELLITE alloy No. 1, resist abrasion from the coke particles and the lining of the oven floor. The hard-faced deposit does not chip or spall under the thermal shock of returning from 1800 deg. F., in the oven, to ordinary atmospheric temperatures.

HAYNES ALLOYS

HAYNES STELLITE COMPANY

Division of Union Carbide Corporation

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taped to a metal sheet clamped to the tracing table.

Cutting operation is begun by manually steering the tracing head toward a short starting line. The tracer is then switched to automatic.

Prior to tracer installation, selection of either manual or template control depended on shape complexity and length of run. Manual control requires continuous operator attention and shapes deviate with each cut. Pattern cost, however, is low and there is no shape limitation.

Aluminum-strip templates are of two types: a knurled drive wheel riding along the strip top, or a drive roller moving on the inside strip surface.

After each cutting run is completed, the strip template is returned to a rack or shelf in a storage area until another production order is requested. If more than a few pieces are to be cut from a given pattern, the greater cost in both material and labor (as compared to manual guiding) is considered justified.

When compared with template flame-cutting, the electronic tracer showed the following advantages:

(1) Reduced pattern costs—in addition to the pattern's lower initial cost, continuing expense of storage and repair is eliminated.

(2) Greater flexibility—a wider variety of intricate patterns can be used since the tracer can follow sharp corners (down to a 3/32-in. radius) and can make acute direction changes.

(3) More freedom in nesting—an assortment of line patterns for short cutting runs can be readily fitted and taped together for maximum use of plate area.

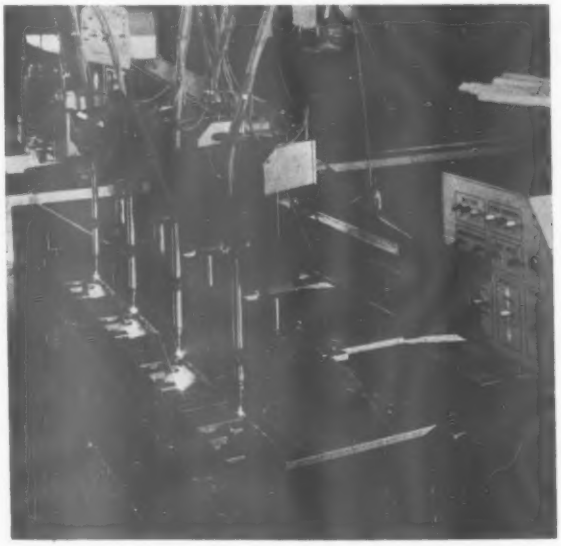
(4) High tracing accuracy—the electronic tracer exceeds all of Whiting's present and anticipated production specifications, and the firm finds its accuracy is superior to that of strip templates.

Since both manual and electronic tracing are based on line drawings, there is no difference in pattern costs or set-ups. There is, however, a substantial difference in total cutting time for any given job.

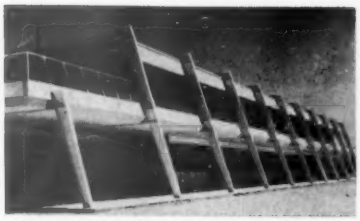
A machine operator must be careful to remain within specified accuracy standards, so manual tracing is necessarily slower: *e.g.*, a 45-ft crane hook cut from 5½-in.-thick mild steel plate using manual tracing required an average of two hours; using an electronic line tracer, 1½ hours.

The relative economic advantages of electronic line tracing are sufficient to warrant a complete changeover from manual and template methods. However, Whiting's welding department still has a large inventory of usable templates which will continue to be used until they become worn or obsolete.

During the changeover period, the electronic line tracer is being used on short-run, non-repetitive jobs for which no template has previously been made. And since the bulk of Whiting's production is in small runs, the tracer-controlled flame-cutting machine is being operated at maximum capacity.



FOUR torches cut stiffener brackets along the front edge of 1½-in. steel plate. Tracer head scans four abutting drawings, giving total of 16 flame-cut shapes for the operation.



ADMINISTRATION-Engineering building. Structures were designed by Pereira & Luckman, Los Angeles. General contractors are Haas-Haynie-Frandsen Inc., Beverly Hills.

Welding vital in lab construction

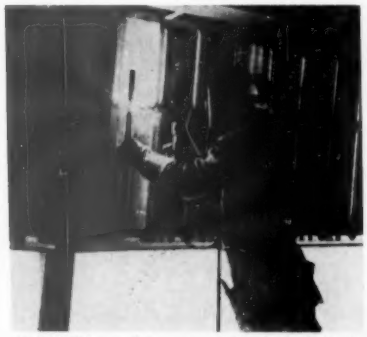
WELDING PLAYED a vital role in construction of the nine-building, $10,000,000 John Jay Hopkins Laboratory for Pure and Applied Sciences at Torrey Pines Mesa in northern San Diego.

All structural steel members and metal decking in the General Dynamics Corp. (General Atomic Div.) project were welded. Manual metal-arc welding, using 5/32-in. E6016 low-hydrogen electrodes on reverse polarity, did the job.

No pre- or post-welding treatment was necessary, but all edges of heavy plate were beveled 45 deg. A 300-amp m-g welder provided current of 180 amps.

A 44,000-sq-ft experimental building housing metallurgical equipment and shop facilities is located on the 300-acre site. Other buildings house fusion, reactor and accelerator equipment, an assembly room, administrative, engineering and technical information services. Two laboratories complete the project.

The facility will be used to conduct a basic research program on controlled thermonuclear reactions, and study various power reactor programs.



WELDOR working on roof of Technical Services building.

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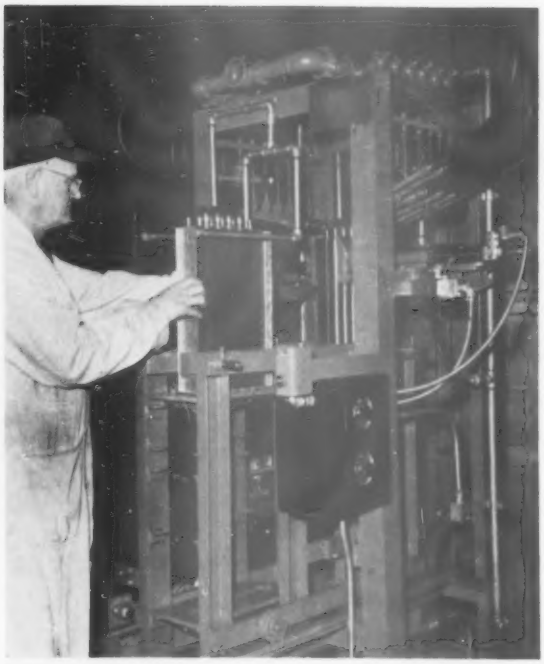
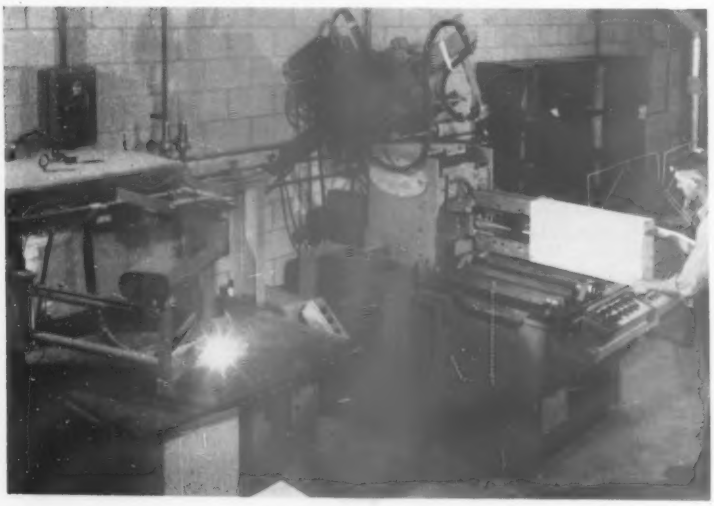


LEFT: Shuttle-type brazing unit designed and fabricated by Gas Appliance Service, Inc., of Chicago, produces heating and cooling coils. Machine brazes U-shaped return bend on coils at rate of from 40 to 50 units per hour. Combination loading and cooling stations (one on each side of heating station) are served by two-position, air-operated carriage with adjustable support fixtures. Multiple gas burner heads (using natural gas-air mixture) are adjustable for various coil sizes and are automatically operated as coil is moved into heating station. Heating is automatically timed, and finished coil receives automatically timed air blast to speed cooling.

On the job...

ABOVE: Intense heat of electric arc melts button of high-purity refractory alloy in protective atmosphere. Work is done at new research and development laboratory of Nuclear Metals, Inc., Concord, Mass. The company dedicated its $2-million structure—housing what is reportedly the largest privately-owned laboratory of its kind in the world—late in 1958. As prime contractor to the AEC and Defense Department, Nuclear Metals has numerous opportunities to apply the electric arc in melting and welding virtually every existing metal.

BELOW: Modern, automated facilities are featured in new Bloomington, Ind., plant of Westinghouse Electric Corp. Plant designs, manufactures and markets capacitors and protective equipment for electric power distribution. Operator is fitting blanked, degreased capacitor case on tangent bender equipped with automatic inert-gas welding head. Case is formed and seam welded, then moved to machine at left where base is welded to it. Mounting brackets are welded to case sides in later operation and capacitor sections are then inserted.



World's largest dump truck

welded with P&H Low-Hydrogen Electrodes

4000 lbs. of P&H 17-1 electrodes used to fabricate 165-ton capacity frame and box

The mammoth "Eucnik" goes Mohammed one better -- it hauls the mountain wherever Western Contracting Corp. of Sioux City, Iowa wants to put it! The specially-built giant moves 165 tons of shale per trip from borrow pit to fill area on the U. S. Corps of Engineers Oahe Dam project near Pierre, South Dakota.

The "Eucnik" represents American co-operative ingenuity at its best. It combines the inventiveness of Hubert Everist, Jr., equipment manager at Western — the new techniques developed by Eaton for fabricating and welding high tensile steel—and the superior weld-ability of P&H 17-1, low-hydrogen electrodes. The result: *a trailer that has twice the tensile strength (110,000 psi) and weighs 12½ tons less* than one made of standard steel!

Take a tip from Eaton — use P&H Low-Hydrogen Electrodes to weld high tensile steels which will be subject to severe impacts and gruelling service. Tensile strengths up to 183,000 psi for fast, X-ray-quality welding with little or no pre-heat. Get Bulletins R-29 and R-26—write Dept. 301B, Harnischfeger Corp., Milwaukee 46, Wisconsin.

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Photo by U. S. Corps of Engineers

Methods and procedures for preheating

Question:

I am just entering the welding field and would like some information on preheating, but have been unable to find a good, general rundown on methods and procedures. Could you help me on this?

Answer:

Preheating base metal prior to welding or flame-cutting operations is a common procedure. Preheat offers these advantages: *(1)* reduction of welding time; *(2)* reduction or prevention of shrinkage stress, and *(3)* reduction in hardness of a weld deposit.

Preheating method depends upon size, shape and composition of material to be welded. In some instances, especially with small pieces or where localized heating is satisfactory, a welding torch may be used for preheating. On other occasions, a specially-designed torch burning city gas, LP gas or oil is used.

A preheating furnace is the most common preheating device. Gas or oil may be used as a furnace fuel, but charcoal is most popular.

Since the temperature attained during preheat should be maintained during welding, the furnace should be constructed to allow removal of various sections without destroying the fire. Firebrick should be used to construct the furnace bottom. Bricks should be spaced to provide plenty of room around pieces being preheated.

Draft holes around the bottom of the wall will insure uniform burning. Charcoal will burn without a draft, and with a draft will develop a white heat. For this reason, never place draft holes near thin sections of pieces being preheated. Draft holes that are too large can be blocked off.

The furnace roof should be made of a layer or two of sheet asbestos supported by steel rod where necessary. A number of holes punched in the asbestos will allow charcoal fumes to escape.

Because of these fumes, furnace preheating should be done in a well-ventilated area. When the preheated part is ready for welding, simply tear holes in the asbestos to permit access to the break.

Most materials must be preheated to a recommended temperature and maintained at that temperature during the entire welding operation. Cast iron may be taken up to red heat (1,000 to 1,500 F) without serious effects; aluminum, however, must not be heated over 800 F. Care must be taken not to overheat metals during preheat.

It is possible to determine approximate Fahrenheit temperatures of ferrous materials (iron and steel) by color changes during heating. Nonferrous materials, however, give no color-change indications, and temperature must be determined in another manner.

The most convenient and accurate means of determining steel temperatures in the black-heat range (below 900 F), and for those metals which do not indicate temperature by color change, is by use of temperature-indicating crayons, pellets or paints.

Temperature-indicating equipment available covers a wide range of temperatures. For example, crayons may be used which melt at 12½-deg intervals between 113 and 400 F, and at 50-deg intervals from 400 to 2,000 F.

All that need be done is to select a crayon which melts at a desired temperature, mark the piece to be heated to that temperature, and heat the piece uniformly until the crayon mark melts. Such crayons are guaranteed accurate within 1%—or within 4 deg for a 400-F crayon.

* * *

In a recent cold wave in Jefferson City, Mo., Joe Kroeger of Kroeger Bros. Welding and Machine Shop ran into a problem which should interest readers using electric welders to thaw frozen water service pipes.

"Cables were hooked to the water line at the nearest point in the basement and just inside the meter at the water main (it was an outside meter), and the welder was started. Under load, the machine acted in a normal manner. However, after 20 minutes (sufficient time to thaw the frozen line), electric service lines to the house burned in half.

"Checking with the power company, it was found that the welder's current had back-tracked from the electric service. The service was grounded to the water line, through the power lines, and back down the power pole to the ground. This was possible because the water line had parted at an underground joint, breaking the circuit.

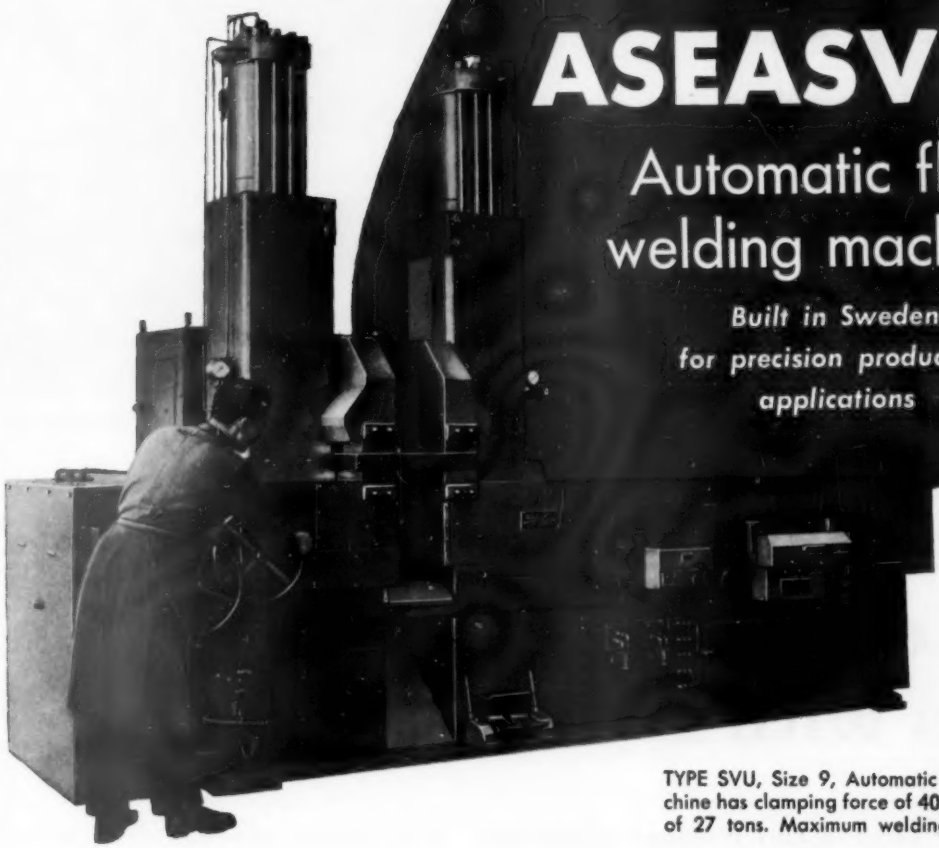
"The power company suggested that, in the future, the ground wire should be disconnected when it is grounded to a house water system, and reconnected only after thawing operations are completed."

Introducing...

ASEASVETS

Automatic flash welding machines

Built in Sweden for precision production applications



TYPE SVU, Size 9, Automatic Flash Welding Machine has clamping force of 40 tons, upsetting force of 27 tons. Maximum welding section 25 sq. in.

Known abroad for their precision performance, ASEASVETS Type SVU Automatic Flash Welding Machines are now available in the United States.

Highly adaptable Type SVU is equipped with hydraulic clamping and motor-operated upsetting and has maximum welding section capacities of up to 40 sq. in.

Automatic control, operated through weld temperature and slide distance, permits predetermination of exact welded length and maintains uniformity of welds when abutting surfaces are uneven.

Machines are available for special purpose applications. They also will be designed to meet your particular needs.

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E. E. Ellis says, "There's nothing to it. This unit will radiograph steel up to 1¾ inches thick."

"In less than a day I could teach anyone to make good inspection X-rays with BALTOSPOT,"

E. E. Ellis

J. B. Fisher

says E. E. Ellis, Welding Engineer and Radiographer, Fisher Tank Company, Chester, Pennsylvania. "One year of experience with Baltospot X-ray equipment proved to us that practically anyone can make good radiographs. There are just three simple steps:

1. measure thickness of part and refer to chart
2. make exposure
3. develop film according to chart

X-ray inspection keeps us on our toes and is far ahead of other methods."

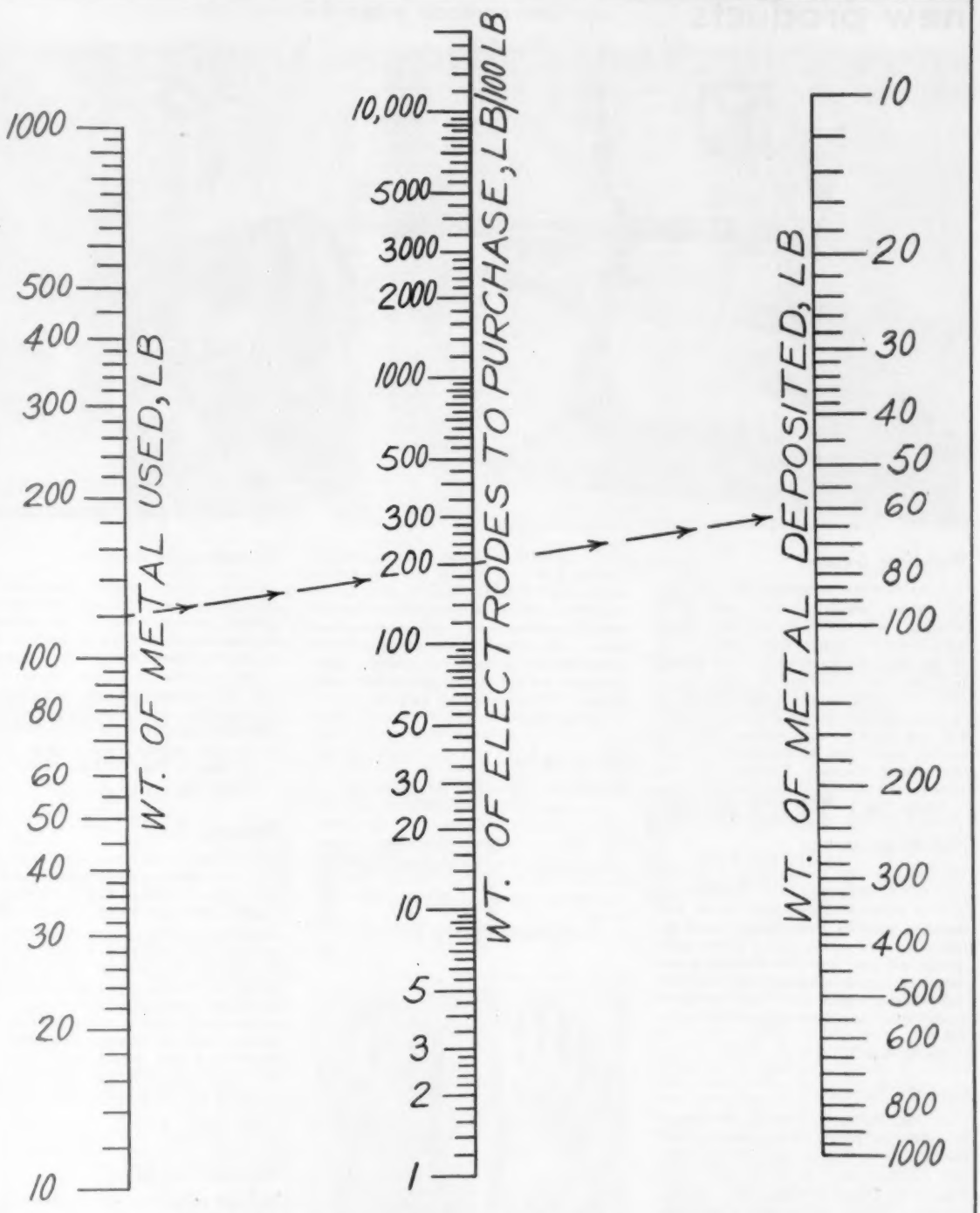
Does Baltospot Pay?

"It certainly does," says J. B. Fisher, President, Fisher Tank Company. "We exercise better control over all phases of work, and save approximately 77 percent in radiography costs. Helping our welders maintain uniform high quality and developing new welding techniques are prime functions of this, the most effective means of testing welds."

Your Westinghouse X-ray Specialist has information on the full line of industrial radiographic-fluoroscopic equipment, or write: Westinghouse X-ray Department, 2519 Wilkens Avenue, Baltimore 3, Maryland. J-08369

YOU CAN BE SURE...IF IT'S

Westinghouse



COMPUTING ELECTRODE PURCHASES

by **Steven D. George**

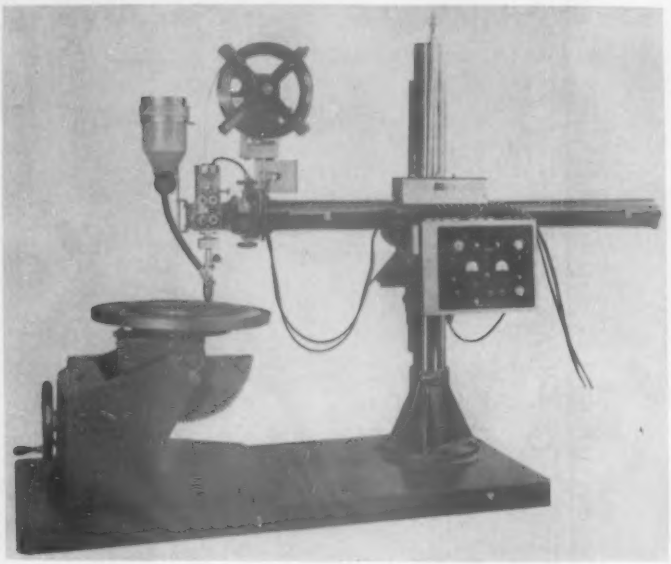
Weld metal needed for a given job, and how much of it is deposited, are criteria in determining weight of electrodes to be purchased. Use this chart to compute electrode weight you will purchase for future jobs.

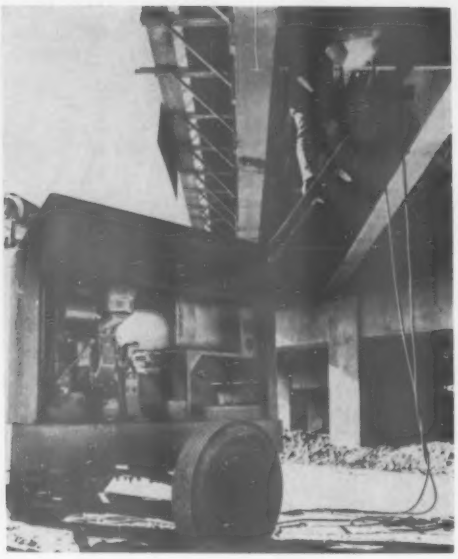
Example: Of every 120 lb of electrodes, a weldor deposits 60 lb. How many pounds of electrodes must be purchased for every 100 lb of metal deposited in work of this type?

Solution: Enter chart on left at weight of metal used *(120 lb)*, and draw a straight line through weight of metal deposited *(60 lb)* on right. At intersection with center scale, read weight of electrodes to purchase as 200 lb per 100 lb of metal deposited.

The chart is based on B=100(U)/D, where B=electrode weight to purchase (in lb per 100 lb deposited); U=weight of metal used; D=weight of metal deposited (lb).

new products . . . use card on page 89





Welding fixture

AUTOMATIC WELDING MANIPULATOR consists of vertical mast and horizontal boom mounted on pedestal or cylindrical type base. Boom has infinite travel speeds from 10 to 150 ipm. Its effective weld length is 42 in. Mast's vertical lift speed is 12 ipm. Boom and mast are powered by ¼ hp, 110 volt d-c motors. Mast pivots 360 deg and locks in any position. Optional control panel can be mounted on unit or remotely mounted. Fusetron time lag fuses protect motors. *Miami Specialties Co.*

Circle No. 1

Safety glasses

UNIBRIDGE safety glasses have a bridge said to fit more than 95% of employees without adjustment. Butt-joint temple construction provides strength and good fit. Spatula, metal paddle and comfort cable temple styles are available. Butyrate frame comes in copper, cordovan and pink crystal. Glasses come with clear or green treated glass or plastic lens. *Welsh Mfg. Co.*

Circle No. 2

Gas-air burner

EXPANDED Multiport P-R Gas-Air burner line combines positive flame geometry with maximum heat release and low turndown, says manufacturer. Can be used for high temperature alloy brazing, heat treating materials, heating solder pots, silver soldering, etc. Burner's multiport refractory screen breaks flame into many small flames. Burner can be used with any commercial fuel gas. *Selas Corp. of America.*

Circle No. 3

Paste solder

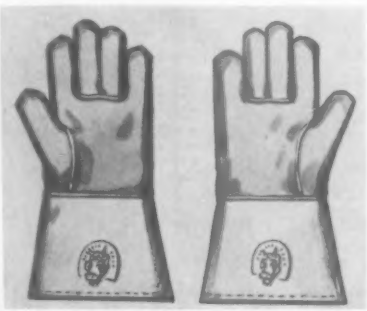
NEW solder-type alloy, in paint-on form, for stainless steels is StainTin 157-PA. It is finely powdered and silver-bearing and suspended in liquid-flux composition. Solder is free of volatile elements and is oxidation resistant. Deposits give up to 15,000 psi tensile strength. Solder can be used for sealing spot welded and wrapped seams, step-soldering assemblies and filling holes. It can be used with steels, copper and nickel alloys as well as stainless steel. *Eutectic Welding Alloys Corp.*

Circle No. 4

Brazing kit

KWIK-KIT, a hard and soft soldering outfit, is designed for maintenance men and service industries. Fluxes are in hand size, unbreakable squeeze bottles boxed by rigid, transparent plastic. Kit may be carried in tool box or on shelf without contents becoming separated. *Special Chemicals Corp.*

Circle No. 5



Reversible glove

SINGER Solo is a reversible weldor's glove of soft, heat-resistant horse-hide. Glove is packaged singly so it can be ordered three at a time instead of as a pair. Comes in brown and green. *Singer Glove Mfg. Co.*

Circle No. 6

Diesel weld power

COMPANY has expanded diesel line to offer single, multiple and turbopowered engines ranging from 20 to 1,650 hp. Lighter-weight units can be used as welding power source. Series 53 includes 2, 3 and 4-cylinder in-line engines of 47, 97 and 130 maximum brake hp. Units can be used for compressing air and gases. Hydraulic starting device eliminates danger of sparking in critical installations. *Detroit Diesel Engine Div., General Motors Corp.*

Circle No. 7

Brazing flux

VOLATILIZING Vapo-Flux eliminates problems when brazing Inconel X, Udimet 500 and other materials usually difficult to braze in hydrogen or dissociated ammonia atmospheres. Flux comes as powder for mixing with powdered brazing alloy, or in solution for coating mating surfaces prior to brazing alloy application. Flux volatilizes during brazing, leaving no residue. It aids wetting and flowing of alloy during furnace brazing, and eliminates need for surface preparations. Alloy can be used for applications requiring 1,800 to 2,000 F temperature. *Wall Colmonoy Corp.*

Circle No. 8

Hardfacing alloy

REXWELD 66 is a hardfacing alloy designed for hot work applications. It is resistant to thermo shock, impact and compressive loads at high temperatures, and will not chip or spall, says manufacturer. The nickel-chromium-molybdenum-tungsten alloy can be used with inert-gas welding. Low-hydrogen coating allows all position welding. Machinability is good with high speed steel tools. *Crucible Steel Co. of America.*

Circle No. 9

MESSAGE #5 *This message is for men who are vitally concerned with such welding problems as maintaining a smooth flow of production... preventing excessive rejects... and insuring trouble-free, economical, profitable operation*

Welding Wire: Cost-saving and Profit Factors

Production men who are conscious of *both cost and quality* agree that a top-grade weld demands the *right* welding wire. *Only* by using wire with an analysis suited to the material to be welded can consistently sound welds—free from porosity and internal cracks—be produced. Use of the right wire means fewer rejects, less waste, lower costs—plus a better finished part or product.

Experienced welding men have long found PAGE a most reliable source of welding wire for all their regular and special needs. The wide range of PAGE analyses—33 of them—makes it possible to select the exact wire that produces the kind of welds that lower production costs and increase profits.

PAGE experience, talents and facilities are available to you at all times. We have been exclusive wiremaking specialists for more than half a century, and are in an ideal position to furnish our customers with the right wire for each specific need. Furthermore, we have developed a broad packaging program which saves time and money by supplying wire packaged to meet any requirement.

These factors, plus PAGE'S nationwide set-up of conveniently-located distributors, backed up by PAGE warehouse stocks, help make it profitable for you to standardize on PAGE Welding Wire.

PAGE offers—
33 ANALYSES
...the right analysis for your welding job

There are *33 different analyses* in the PAGE line, covering the broadest range of applications: submerged arc...inert gas...tungsten or metal arc...oxy-acetylene gas welding...metal spraying.

For example—ANALYSIS A-S-10

...A low carbon mild steel, Analysis A-S-10 is the "work-horse" of the PAGE line of bare (copper coated) welding wire. It is made from rimmed steel with closely controlled carbon, manganese, phosphorus and sulphur with only a trace of silicon. Its chief use is for submerged arc welding where with a neutral flux it will give a tensile of 55,000/60,000 p.s.i. with an elongation ranging up to 35%. The tensile can be raised by using flux containing carbon, manganese, or other strengthening alloys, or by using hard-facing fluxes a hardness of Rockwell C-35 to C-50 can be attained.

Because of its lack of deoxidizing agents (silicon, aluminum, etc.), it is not a suitable wire for high class CO_2 welding as it has a decided tendency towards porosity in the weld metal.

For example—ANALYSIS A-S-15

...Our Analysis A-S-15 is an aluminum-killed mild steel wire with approximately 2% manganese with phosphorus, and sulphur held below .025%. Used with a neutral flux or inert gas, it shows appreciably higher tensile strength and as good an elongation as A-S-10. It gives a very clean deposit and is used where higher physical requirements warrant its higher cost. It will give a tensile strength of approximately 75,000 p.s.i. with an elongation of 40%.

For example—ANALYSIS A-S-16

...This is the same analysis as A-S-15 with ½% molybdenum added. The molybdenum gives it additional tensile strength—up to 85,000 p.s.i. with neutral flux or inert gas—but reduces the tensile to about 20%. It is chiefly used for welding the carbon-molybdenum alloys (AISI-4012 to 4028 series) or wherever the importance of the higher tensile justifies its use. It will give a tensile strength of approximately 85,000 p.s.i. with an elongation of 20%.

NOTE: previous advertisements in this publication have included brief descriptions of PAGE Analyses A-S-8620, A-S-6150, A-S-30, A-S-NAX-9115, A-S-65, A-S-Armco Iron, A-S-6 and A-S-17. Detailed information on all 33 PAGE analyses is contained in our Welding Comparison Chart DH-1218.

Write for—Welding Wire **Comparison Chart DH-1218**....This new, highly informative, four-page chart lists detailed analyses of PAGE automatic welding wires, metal spray wires, bare electrodes and gas welding rods. Also shows uses and physical properties, including: tensile strength, elongation, Rockwell hardness. Chart lists virtually all competitive makes.

Write for—Submerged arc and inert gas welding wire **Folder DH-402A**...also gas welding rod **Booklet DH-1277**.

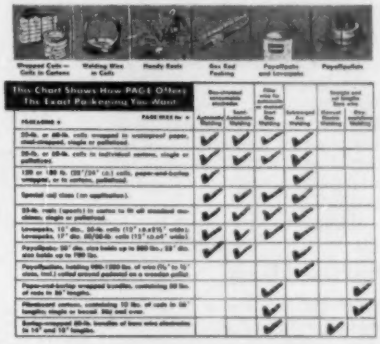
PAGE offers—
Packaging to meet your needs

PAGE Welding Wires are packaged in a wide variety of ways—for the most complete protection and the utmost convenience in handling, in stocking and in use. Here are some major types of PAGE packaging:

1. **Paper-wrapped Coils**
2. **Coils in Cartons, Palletized**
3. **Bare Coils (packed in Leverpaks)**
4. **Masonite Reels**
5. **Payoffpaks**
6. **Payoffpallets**
7. **Gas Rods in Burlap-wrapped Bundles**
8. **Stainless Gas Rods in 10-lb. Tubes**

For example—

PAYOFFPAKS...Up to 700 lbs. of wire, without a single weld...coiled around a fiberboard cylinder within a fiberboard drum...ready to be smoothly unreeled to the welding head for automatic or semi-automatic welding! Eliminates costly machine down-time for coil replacement. Payoffpaks come in three sizes: 20" diameter (holds 250 or 500 lbs.); 23" diameter (holds up to 700 lbs.).



Write for—**PAGE Welding Wire Packaging Chart.** • This useful chart shows the many kinds of packaging of PAGE Welding Wires for each type of welding.

• • •

PAGE offers—
Availability from local stocks

Here is a handy service that not only gets you the welding wire you need when you need it, but saves you money by making it unnecessary for you to tie up a sizeable investment in wire inventory.

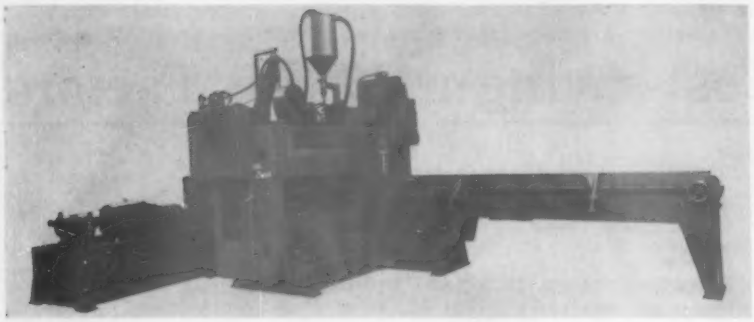
You can get the exact PAGE automatic welding wire and welding rods your job requires direct from your nearby PAGE Distributor. Located at many points from coast to coast, PAGE distributors carry sizeable stocks for your convenience—and they are backed up by PAGE Warehouses at the strategic locations shown below. Close cooperation between PAGE distributors, PAGE warehouses and the PAGE mill is your guarantee of prompt, intelligent, individual service on your specific needs.

ACCO

Page Steel and Wire Division
AMERICAN CHAIN & CABLE

Monessen, Pa.*, Atlanta, Chicago*, Denver*, Detroit, Houston*
Los Angeles*, New York, Philadelphia*, Portland, Ore.
San Francisco*, Bridgeport, Conn.
**Indicates PAGE warehouse stocks*

ACCO for Better Values



Splicing machine

STRIP splicing machine is designed for use in continuous tube mill installations. It splices coil stock up to 14-in. wide and ¼-in. in diameter. Machine consists of entrance table, double-down cut shear, a submerged arc welding station and broaching station. Weld is made in one pass. Top and bottom of weld bead is broached so skelp can go through succeeding rolls without shock. Mill is hydraulically powered and semiautomatically operated. *Berkeley-Davis Inc.*

Circle No. 10

Spring clamp

EDGELOCK is a low-cost spring clamp for holding edges of two or more thicknesses of wood, metal, plastic and other workable materials. The clamp has a grip capacity of 65 lb, jaw opening of 1-in. and weighs about one ounce. The spring is completely enclosed for protection of operator and clamp. Edgelock is set and released with clamp-setting steel pliers. *Wedgelock Corp.*

Circle No. 11

Push, pull clamps

KNU-VISE push and pull clamps come in hand, air or oil operated models for remote control with 85 psi. Clamps are designed to apply up to 1,200 lb force. Swivel base model provides 90 deg change in clamping direction. Clamping force is not affected by failure of air or oil pressure. *Lapeer Mfg. Co.*

Circle No. 12

A-c/d-c electrode

ELECTRODE No. HS-4 is for a-c/d-c hardfacing or welding of manganese and carbon steel. Electrode's weld strength is 58,000 psi and tensile strength is 125,000 psi. Elongation is 50%, hardness as deposited, 18-22 Rockwell C, hardness after working, 44-50 Rockwell C. Comes in ⅛, 5/32, 3/16 and ¼-in. core sizes, packed in 10-lb containers, 6 to a carton. Can be used for reclamation by buildup of crusher rolls and hammers, etc. *All-State Welding Alloys Co., Inc.*

Circle No. 13

Liquid oxygen cylinder

PORTABLE liquid oxygen cylinder, LC-3, is a double-walled, insulated container capable of holding 3,000 cu ft of oxygen. Cylinder is designed so gas pressure inside is always above setting of delivery regulator, and below that of relief valve, so no gas is lost. Built-in heat exchanger automatically vaporizes and warms as much gas as is needed to a maximum of 300 cu ft an hour, continuous service, or 1,000 cu ft an hour, intermittent service. Cylinder can be used with liquid argon and nitrogen, and can be manifolded. *Linde Co.*

Circle No. 14

Welding clamp

SPATTER-proof clamp has 8,000 lb pressure resistance. Jaw is 5 in. deep, bar is 2 in. wide, ½-in. thick, jaw openings are from 12¾ in. to 18¾ in. Screw and button can never become stuck with weld spatter and can never rust, says manufacturer. *Peck Clamps.*

Circle No. 15

Grinding discs

SPITFIRES, aluminum oxide grinding discs designed for safe operation, are solvent, waterproof and have reinforced edges. Built-in shape control eliminates limpness and disintegration. Special, standard and heavy-duty models can be used for light or heavy weld and braze removal and high-speed finishing. Grit sizes 16 through 180 are available. Diameters include 6, 7, 8 and 9⅛ in. sizes with ½ and ⅞-in. arbor holes. *Abrasive Products Inc.*

Circle No. 16

Pipe thawer

PORTA-THAW is a small transformer for thawing pipes. It can be used on ordinary 110/220 volt, single phase, 50 to 60 cycle a-c electric circuit. Unit includes 10-ft power cable with plug, receptacle, two 20 ft thawing cables with lugs and clamps, and case. Transformer is rated at 300 amp, 10 volts on 100% duty cycle. Four output terminals provide for three thawing steps—high, medium and low. Instructions are permanently mounted on case. *Hobart Bros. Co.*

Circle No. 17

Cleaning gun

VON ARX air gun cleans and de-scales by means of rapidly reciprocating hardened steel needles striking surface being worked. Gun operates on normal air pressure consuming a maximum of 13 cu ft per minute. Cleaning needles conform to contour of work, permitting thorough cleaning of irregular surfaces. Especially useful for weld cleaning operations, says manufacturer. *Mar-Indus Co.*

Circle No. 18

Balancing machines

REUTLINGER Electrodynamic balancing machines come in 14 models of GW series, which balance from 1 oz to 600 lb, or in WM series, which handle several thousand lb. Machines have hydraulic belt lifters and finger tip controls. Guaranteed accuracy is less than 0.00001-in. final eccentricity of balanced workpiece. Machines have speeds up to 30,000 rpm. Extra cradles are available. In continuous production unbalance can be located in less than 25 seconds, says manufacturer. *Wharton Unitools.*

Circle No. 19

Aluminum solder

ULTRALLOY is a solder for bonding aluminum to non-ferrous metals. It can be used to make permanent electrical connections in television, radio, radar equipment, etc. Used like any other solder, it requires no special flux, skill or equipment. It is corrosion resistant and retains its color after applications. Copper content gives solder high electrical conductivity. Melting point is between 700 and 750 F, elongation is 20% in 2 in., Brinnell hardness is 23. *Ultralloy Corp.*

Circle No. 20

Tube bender

PRECISION tube bender for bending thin walled stainless and aluminum tubing has been added to company's Consensus line. Unit bends stainless steel tube in sizes to 5 in. OD by 0.085-in. wall, or aluminum tube to 6 in. OD by 0.065-in. wall. Bending is remotely controlled by a hydraulic circuit. Micrometer positioning dials, degree of bend dial and length gages are built in. *Wallace Supplies Mfg. Co.*

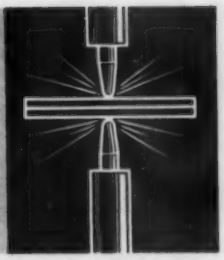
Circle No. 21

P R MALLORY & CO Inc

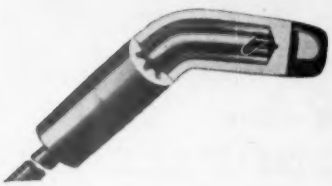
MALLORY MEMOS

NEWS AND TIPS ON RESISTANCE WELDING

P. R. Mallory & Co. Inc., Indianapolis 6, Indiana



WELDING HINTS

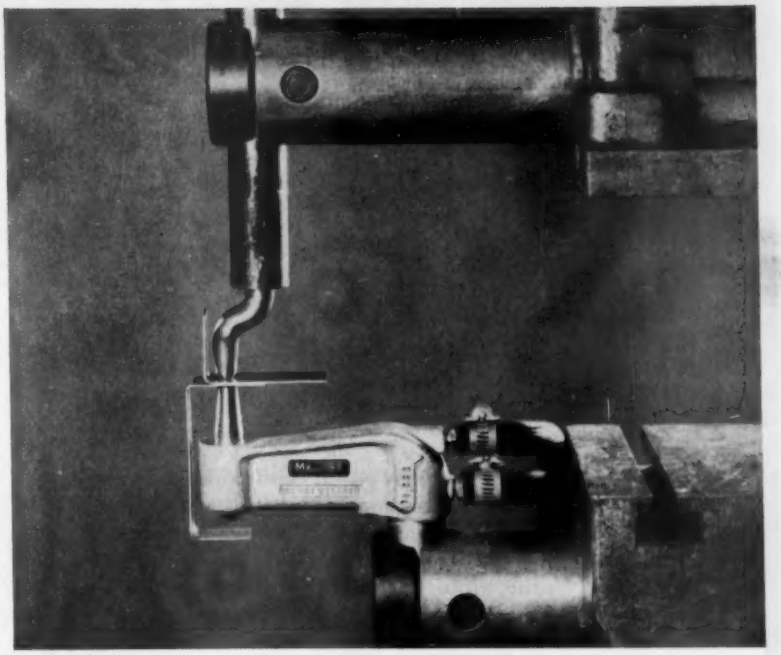


Cooling tubes in holders should be adjusted to extend within ½" of the end of the hole in the electrode, to get correct flow in the electrode. (Mallory bent electrodes have cooling tube bent in place*, to make sure water flows all the way to the tip.)

*U.S. Patent 2,489,993

Choose electrode size. Don't use small electrodes on heavy gauge work, or large tips on light gauge stock.

Write for this wall chart of "Do's and Dont's of Resistance Welding."



Tricky welding set-ups? Solve them with MALLORY standard electrodes!

Maybe you've always figured you need custom-designed electrodes to make welds in tight corners, on inside joints and other difficult locations. Before you go to the extra cost and delivery delay of "specials", see the broad range of unusual electrode shapes that you can get as standard models from Mallory.

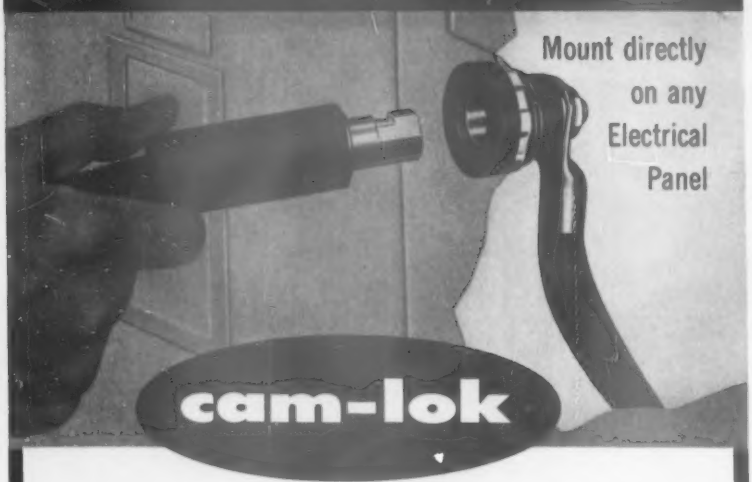
The Mallory standard line includes 51 different irregular shape electrodes . . . single bend, double bend, offset . . . in a range of sizes and alloys. You'll probably find exactly the size and shape you need for that special job. You'll get it immediately. And it will be far more economical than a tailor-made electrode . . . far more serviceable than one you might bend or braze together in your own shop, because it's made of Mallory alloys by advanced Mallory production methods.

You'll find the most complete range of electrodes in the Mallory standard line . . . 113 different Straight electrodes with various tip designs . . . 30 different Elkonite®-faced electrodes . . . 10 different socket types . . . 37 different threaded electrodes. Many are available with the Mallory fluted cooling hole for long life.

Mallory welding products are available from authorized distributors located in all principal cities.

New Hi-Impact Plastic Insulated

Panel Receptacles and Mating Plugs



Now, you can make fast, positive power connections to any metal panel or housing without special insulating materials. Simply punch out a hole and insert a Cam-Lok self-insulated Receptacle! Uses standard electrical lock-nuts, affords "dead-front" protection. Push in and twist Cam-Lok mating Plug and you've made a locked connection, which can be released quickly.

New Cam-Lok Receptacles eliminate costs of special insulating panels and reduce assembly time. Patented, high-pressure contact assures minimum resistance and heating.

Cam-Lok has a complete line of Receptacles and Plugs in many sizes and designs. Standard and special purpose Power Distribution Connections are available. Write today for new Bulletin No. 301.

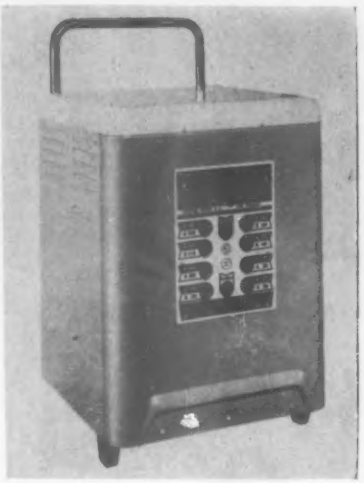
"Dead Front" design for fast
direct mounting on . . .

- ELECTRICAL DISTRIBUTION PANELS
- SWITCHGEAR
- BUS DUCT
- JUNCTION BOXES
- WIREWAY or any electrical cubicle

A Complete Line of Welding Accessories and Special Power Distribution Connections

cam-lok DIVISION

EMPIRE PRODUCTS, INC.
P.O. BOX N-98
CINCINNATI 36, OHIO



Arc welder

FIRM has new line of a-c arc welders for farm, school and maintenance shop use. Fan cooled units come in 90, 180 and 295 amp sizes. On-off switch and wheels are included. Welders have 80 volt open circuit to permit use of low hydrogen and stainless steel electrodes. *Emerson Electric Mfg. Co.*

Circle No. 22

Work glove

PERMATEX is a new cotton vinyl-impregnated work glove used in inspection, handling small parts and other jobs where careful handling is required. Cotton material is flexible, liquid-repellent, odorless and washable, says manufacturer. Gloves are available in men's and women's sizes. *Advance Glove Mfg. Co. of Detroit.*

Circle No. 23

Gouging torch

MODEL Q-3 automatic torch can be used to prepare joints for welding. Unit has mechanism which feeds consumable copper-coated carbon-graphite electrodes as needed. Head is tractor-mounted permitting straight line or circular travel at predetermined speeds. Head can be mounted on positioning equipment in same manner as automatic welding head. It can be set at any angle, and will handle Copperclad electrodes from 3/16 to 3/8-in. in diameter. Tractor can travel from 6 to 180 ipm. *Arcair Co.*

Circle No. 24

FEBRUARY 18, 1959
KANSAS CITY, MISSOURI

69 WELDING UNITS

INCLUDING CONTROLS FOR STAINLESS STEEL WELDING

30-KVA Portable Spot
75-KVA Portable Spot
75-KVA Stationary, Floor Mounted
50-KVA Stationary, Floor Mounted
75-KVA Rocker Arm, Floor Mounted
50-KVA Rocker Arm, Floor Mounted
100-KVA Circular Seam, Floor Mounted
100-KVA Longitudinal Seam, Floor Mounted

also Motor-Driven and Rectifier-Type Arc and Heliarc Welding Units

All the above are equipped with controls and panels necessary for stainless steel welding and for the special techniques required in aircraft industry manufacturing.

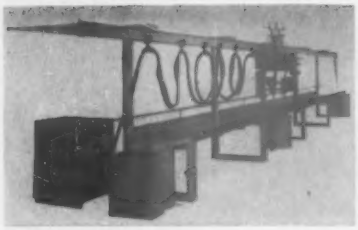
The machines have been subject to continuous maintenance and are in *good operating condition.*

Additional lots to be sold at auction include: turret lathes; mills; grinders; mutiple spindle drills; horizontal boring machines; dust collectors; belt polishers and miscellaneous equipment.

Auction Date: February 18, 1959
Viewing Period: February 2-17, 1959

SEND FOR FREE ILLUSTRATED CATALOG

Write: Property Disposal Department
AVIATION GAS TURBINE DIVISION
Westinghouse Electric Corporation
95th & Troost — Kansas City, Missouri
P.O. Box 288 — Phone: DE 3-7400



Track-link machine

TRACK-LINK rebuilding machine, Model TLM-2, has two wire feed units for welding both links simultaneously. It also has an electronic eye, accompanying patterns that decrease set-up time and offer intermittent welds, and flux handling and dispensing equipment. A single welding console encloses two 500 amp, 100% duty cycle, three phase constant-potential welding power supplies. *L & B Welding Equipment Inc.*

Circle No. 25

Ceramic tooling

VARIETY of ceramic tool components are available through service developed for design and production engineers who want standard ceramic tool parts for brazing, soldering and welding fixtures. Components are heat resistant to 2,000 F. Round and square rods ¼ to ½-in. in diameter, washers to 2 in. OD, discs to 6 in. OD, plates 5 by 6 in. and plain and shoulder bushings up to 3 in. OD. are available. *Duramic Products Inc.*

Circle No. 26

Aluminum pipe

UNISTRENGTH pipe is seamless and has thin walls with standard wall thickness at pipe ends. Metal is concentrated at pipe ends, usually weakest link in piping system. Pipe is adaptable to all joining methods, especially welding, says manufacturer. Ratio of thick to thin walls is selected to provide uniform bursting, tension and bending strength along pipe's length after welding. Pipe is available, in 40-ft lengths, in alloys 6063-T6 and 6061-T6 with schedule 40 wall thickness at ends. *Aluminum Co. of America.*

Circle No. 27

Protective clothing

NEW LINE of aluminized flame-proofed rayon protective clothing, Wheelers 70, was developed to provide strength, radiant heat resistance and stability under flexing. Coats, aprons, sleeves, pants, leggings, hats, spats, shoe covers and gloves come in complete range of sizes. *Wheeler Protective Apparel Inc.*

Circle No. 28

Squeeze-bottle solder

EUTEC-TIN-WELD T-1 is a solder-type alloy in paste form applied with plastic squeeze bottle or through automatic applicators. Alloy has been formulated to avoid settling of heavier materials. For use by electronic, jewelry, automotive and plumbing industries. *Eutectic Welding Alloys Corp.*

Circle No. 29

Welding control

SYNCHRONOUS electronic control, Model 10E49E-A, is designed for use with all types of small resistance bench welders. Unit is suited for welding of small parts such as those found in dental equipment, watches, optical products, etc., says manufacturer. Available for 115/230 volt range. Control is equipped with two plug-in thyratron firing tubes. Thyratron contactor is rated 12 amp at 50% duty cycle with a 5-second averaging time. *Robotron Corp.*

Circle No. 30

Marking paint

PENAPAINT is a marking material that can be applied to bare metal before or during fabrication to identify iron or steel sections, and which instantly penetrates subsequent paint coatings. Penapaint remains on section until no longer needed, then is removed by using Penapaint Mask, a specially compounded material through which Penapaint will not penetrate. *Phillips Products Inc.*

Circle No. 31

Tempilstik° FOR ALL HEAT-DEPENDENT OPERATIONS

looks like a crayon... marks like a crayon... tells temperatures like a precision instrument!

Available in these Temperatures (F.)

113	375	1000
125	388	1050
138	400	1100
150	413	1150
163	425	1200
175	438	1250
188	450	1300
200	463	1350
213	475	1400
225	488	1450
238	500	1500
250	525	1550
263	550	1600
275	600	1650
288	650	1700
300	700	1750
313	750	1800
325	800	1850
338	850	1900
350	900	1950
363	950	2000

Sixty-three different compositions enable you to determine and control working temperatures from 113° to 2000° F.

TEMPILSTIK° marks on workpiece "say when" by melting at stated temperatures — plus or minus 1%.

ALSO AVAILABLE IN LIQUID AND PELLET FORM . . . WRITE "WELDING SALES" DEPT. FOR SAMPLE TEMPIL° PELLETS . . . STATE TEMPERATURES OF INTEREST—PLEASE!

Tempil° CORPORATION 132 WEST 22ND STREET, NEW YORK 11, N. Y.

A-c welder

A-C WELDER for manual or automatic fixture Tig arc-welding almost eliminates d-c element in power supplied. Manufacturer guarantees arc stability and positive control of high open circuit of 165 volts. Absence of capacitors removes possibility of arc-outs. Unit includes voltage reducer for manual welding and remote amp control receptacle. Current ranges are 10-165, 20-260 and 135 to maximum. Current is rated 300 amp, 60% duty cycle at 40 volts. *Miller Electric Mfg. Co.*

Circle No. 32

Portable abrasive unit

ABRASIVE BELT radii finishing hand tool weighs 1 lb, yet is capable of producing approximately 4,000 surface feet per minute, running at 17,000 rpm. Can be used for spot metal finishing, de-burring and de-edging. Tool has three usable sides, nose for large or small radii, long side for large radii and convex surfaces and top for flat work. Comes with three abrasive belts, one drive sheave and clamp for attaching air motor. *Peterson Tool & Mfg. Corp.*

Circle No. 33

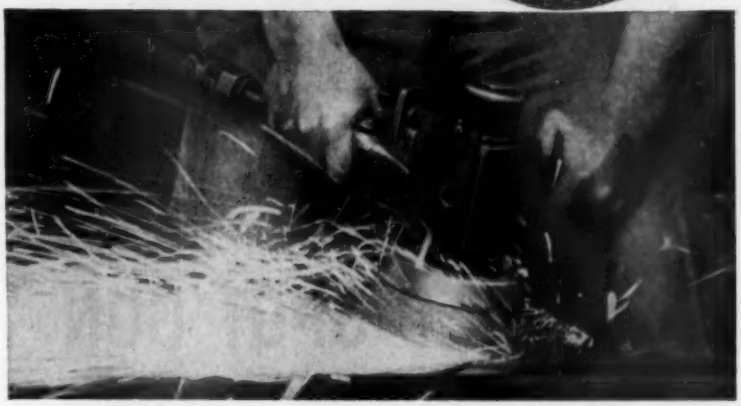
Brazing alloy

BRAZING alloy available in powder form or impregnated plastic wire is easily applied by unskilled personnel. Wide-gap Nicrobraz was developed for high-temperature service, especially for use in gaps up to 0.050 in. *Wall Colmony Corp.*

Circle No. 34

ATLANTIC WHEELS

float through the roughest jobs...



Even on the toughest flash and weld removal operations, you can depend on Atlantic Grinding Wheels for fast, cool, clean-cutting action. Made with a special resinoid bond to withstand high centrifugal forces and assure maximum safety, they have a smooth, floating action that calls for less pressure on the grinding surface . . . helps reduce operator fatigue and increase efficiency.

If you have any type of metal removal or smoothing problem, it will pay you to give Atlantic Grinding Wheels a trial run. An Atlantic representative will be glad to recommend the right wheel for your specific requirements. Write for details and a copy of the Atlantic Grinding Wheel Catalog. Atlantic Abrasive Corp., 540 Pearl Street, So. Braintree, Mass.

Atlantic Abrasive Corp.

A DIVISION OF ABRASIVE PRODUCTS, INC.

South Braintree 85, Massachusetts

STRAIGHT WHEELS • CYLINDER WHEELS • CUP WHEELS
CONES • PLUGS • MOUNTED WHEELS AND POINTS

☐ Please send Atlantic Abrasive Catalog.

☐ Have Sales Engineer call without obligation.

NAME_____

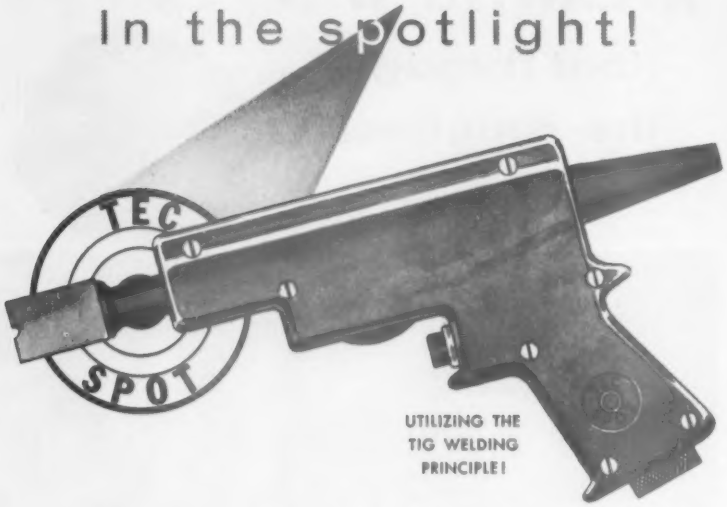
POSITION_____

COMPANY_____

STREET_____

CITY_____ STATE_____

In the spotlight!



UTILIZING THE TIG WELDING PRINCIPLE!

the TEC SPOT GUN

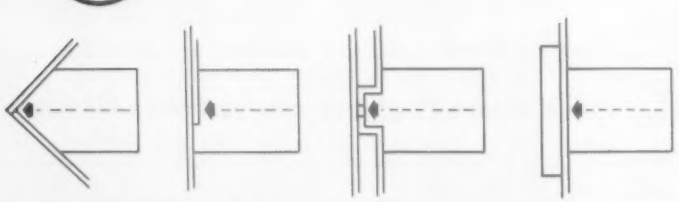
Perfectly meeting the demand for a production tool to bridge the gap between resistance welding and arc welding.

Spot weld all gauge thickness joints from ONLY ONE SIDE . . . weld up to 1/8" thickness to ANY STOCK SIZE regardless of THICKNESS . . . uses Argon and/or Helium gases.

Exclusive tip-of-torch cooling . . . touch starting is eliminated through high frequency initiation and no pressure is required

LIGHTEST WEIGHT TIG spot gun on the market . . . ONLY 12 OUNCES! Modern design to comfortably fit the operator's hand for faster operation.

ECONOMICAL . . . Maintenance is practically eliminated because there are no moving parts to wear.



Eight standard Locators available for most job applications. Locators for special joints available on request.

Write NOW for full information on the TEC Spot Gun and other Superior Visuweld Equipment

TEC TORCH CO., INC. 300 PATERSON AVENUE CARLSTADT, NEW JERSEY

Small-size welder

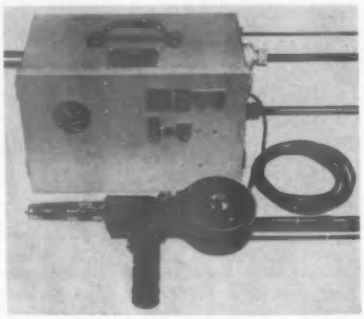
WILDCAT employs a full 50% duty cycle and provides weld heat fully variable through 50 to 200 amp range. Sliding shunt allows heat control to exact amp without steps or jumps. Unit operates on a low line draw of less than 30 amp to meet REA specifications. Open circuit voltage between electrodes is 40 volts. Includes 6-ft power cable with 220 volt three-prong plug, 7-ft ground cable with clamp and an 8-ft cable with electrode holder. *Radson Engineering Corp.*

Circle No. 35

Generator

LIQUID-nitrogen generator is small yet able to produce more than 4 liters of pure liquid nitrogen per hour for continuous periods up to 200 hours. Evaporation losses are minimized since liquid nitrogen is produced only when needed. Gas liquifier needs 240 gallons of water per hour. *Philips Electronics Inc.*

Circle No. 36



Mig welder

SIGMETTE, designed for portable Mig welding, is rated at 200 amp. Wire spool mounted on torch allows operator to get at jobs in confined spaces and areas far from power and gas supply. Torches are available for full welding range with either 0.030 or 1/16-in. aluminum wire. Torch can handle full welding range with 3/64-in. aluminum wire; applications on aluminum 0.093 to 1/8-in. thick using 0.030-in. wire up to 125 amp; limited applications with 1/16-in. aluminum wire and 0.030-in. carbon steel wire. Torch and component control are fully insulated. *Linde Co.*

Circle No. 37

NEWS . . . . . *from page 8*

welding alloy development are planned. The new laboratories will work with the research center opened last October by a Eutectic affiliate in St. Sulpice, Switzerland.

Five warehouse-service centers, similar to the 11 Eutectic already has, will be opened in Boston, Pittsburgh, Baltimore, Philadelphia and Vancouver, B. C.

Also to be expanded is the company's force of technical representatives who contact firms to show them Eutectic's latest developments, and offer aid in operation of customers' welding activities.

Wall Colmonoy names Milwaukee brazing jobber

Industrial Products Engineering Co., Milwaukee, has been named Minnesota, Wisconsin and upper Michigan representative for the Stainless Processing and Wallco Mfg. divisions of Wall Colmonoy Corp., Detroit. The divisions perform contract brazing services.

Ekstrom purchases Hi-Lo a-c welder

Ekstrom Electric, Detroit, has purchased tooling and the manufacturing rights for the Hi-Lo a-c arc welder line from Hi-Lo Mfg. Co., Detroit.

Vacuum brazing developed for honeycomb structures

F. J. Stokes Corp., Philadelphia, has developed and is building production scale equipment that will use a new industrial-type vacuum brazing procedure. The equipment will be sold as complete package systems.

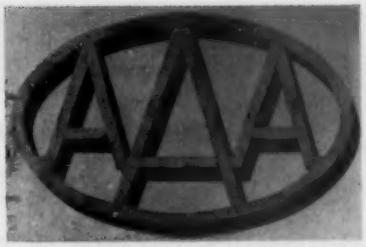
The design of the equipment eliminates making welded envelope enclosures for the work and permits rapid loading and unloading of panels. It operates at 1,700 F, and provision is made for rapid cooling of work once brazing material has fused.

The high vacuum atmosphere created for the equipment eliminates need for an inert gas. Vacuum was chosen for the inert atmosphere because both core and skin in honeycomb structures are prone to form oxides that resist good bonds.

Inert gases are said to have contaminants in them no matter how thoroughly they are dried. A vacuum atmosphere contains no contaminants.

Gevaert opens Texas warehouse

The Gevaert Co. of America Inc., New York City, has opened a Dallas warehouse and office to serve Texas, Oklahoma, Arkansas and Louisiana. Jack Gilbert is Dallas district manager.



BRONZE sheet metal was used to make three insignia, as one above, for Automobile Club of Washington. All-State Alloy No. 430 and 430 non-acid flux were used when soldering hundreds of pieces needed for insignia. Soldering with special flux and alloy resulted in $530 saving over cost of silver brazing. Soldering also provided more strength to joints than brazing.

Safety booklets available from NSC

"Are you safety minded?" and "The professional touch," are two safety booklets available from the National Safety Council, Chicago.

The first booklet tells how to create safety mindedness in employees so they can learn to work in dangerous areas without injuring themselves or their co-workers. The second booklet gives safe driving tips.

Single copies and information about quantity prices are available from the NSC, 425 N. Michigan Ave., Chicago 11.

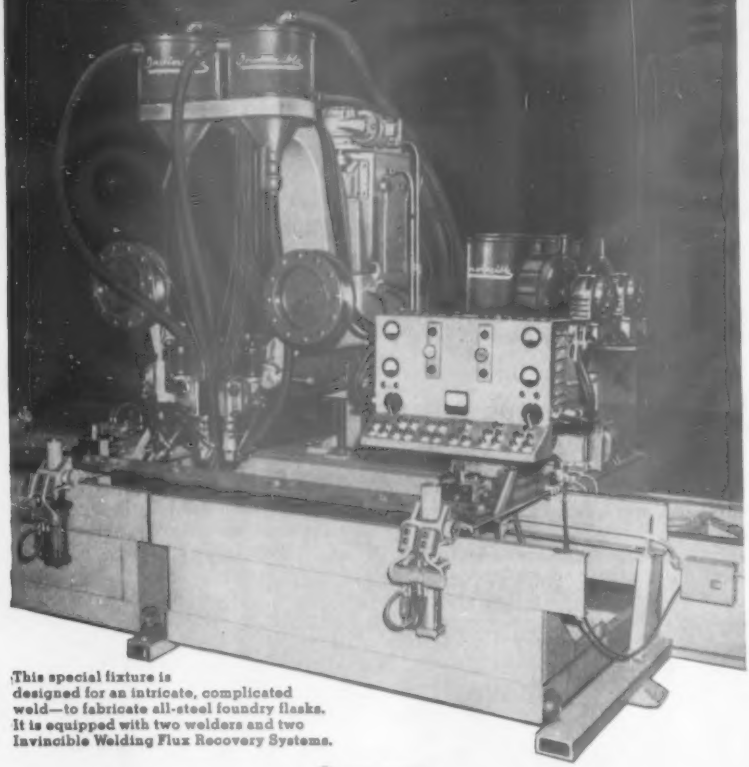
R. G. LETOURNEAU Inc., Longview, Tex., constructed and is delivering this 1,000-ton self-elevating island to Italian government. Platform can be raised and lowered. Triangular hull is 120 by 115 by 13 ft. Island will hold derrick and other equipment for oil drilling operations in Iran waters. Structure is being floated 10,000 miles, from firm's Vicksburg, Miss., plant to Persian Gulf.

NATIONAL Eutectic Weldors' Clubs have named Greta Thyssen "Miss Weldor of 1959." The former Miss Denmark has appeared on television, in movies and on the legitimate stage.

Welding Fixture and Positioner Manufacturers Specify . . .

INVINCIBLE

WELDING FLUX RECOVERY SYSTEMS



This special fixture is designed for an intricate, complicated weld—to fabricate all-steel foundry flasks. It is equipped with two welders and two Invincible Welding Flux Recovery Systems.

Because:

- INVINCIBLES recover *all* unfused flux on submerged arc welding jobs, remove powder and return slag-free, dust-free flux to the welder in a *continuous* flow. Savings in reclaimed flux *alone* repay their cost in a few months, or even weeks. And they save costly man-hours over manual methods, speed production, minimize costly rejects by eliminating flux flour.
- INVINCIBLES are available in 14 standard automatic and manual models from 1½ to 7½ horsepower *plus* special machines and combinations. All feature compactness, flexibility and rugged construction.
- INVINCIBLE's resident engineers in all principal cities will assist you in achieving maximum savings from submerged arc welding operations.

SEND FOR FOLDER on Invincible Flux Recovery Systems

INVINCIBLE VACUUM CLEANER MFG. CO.
DOVER, OHIO

OVER 50 YEARS THE LEADER IN INDUSTRIAL VACUUM EQUIPMENT

TWO Linde torches cutting through several billets. No finishing will be needed when cuts are completed.

Iron powder used in flame-cutting

Pittsburgh Steel Co., Allenport, Pa., is using a new flame-cutting machine with a special iron powder to boost output and slash production costs.

The automatic machine produces 1,000 billets during an eight-hour shift. Billets 3½ to 7½ in. in diameter are cut into 4 to 12 ft lengths. Mild steel, high carbon steel and 4 to 6% chrome alloy materials can be processed. When cutting operation is completed billets are fed into seamless tube hot mills and made into tubing ranging from 2⅜ to 8¼ in. OD.

Powder-cutting, used instead of shears, increases operation speed, prevents elliptical shaped ends and cracking.

Linde Co. engineers worked with Pittsburgh Steel in designing and building the machine. Its basis is two Linde cutting torches mounted on a carriage that automatically controls cutting speed. Iron powder is fed into cutting oxygen stream from a pneumatic powder dispenser during the operation.

Ramo Wooldridge, Thompson merge

Ramo Wooldridge Corp. and Thompson Products Inc. have merged, the new company known as Thompson Ramo Wooldridge Inc. The names of all Thompson divisions will remain the same, while the Tapco Group and Ramo-Wooldridge will retain their names and operate as divisions of the parent company.

Space Technology Laboratories, Inc., now a separate corporation, will perform its special services for the United States Air Force without any operational connection with the new company.

Tractor rebuilders form association

The National Association of Independent Construction Machinery Parts Distributors and Rebuilders was formed at a recent meeting of 125 tractor parts rebuilders, parts manufacturers, suppliers and distributors at Roanoke, Va.

President of the new association is Sam Maximon, Maximon Machine Co., Inc., Altoona, Pa. Other officers elected were, vice president, Edwin Hess, Allied Welding & Mfg. Co., Hillside, Ill.; secretary, Harry Cooke, Automatic Welding Co., Waukesha, Wis.; and treasurer, Clarence A. Goss, Goss Supply Co., Zanesville, O.

The new officers are planning first annual convention of the association to be held in June.

Prior to the three-day meet a six-man steering committee developed all preliminary considerations for forming a new association. The committee was composed of William Hilts, Interstate Equipment Corp., Roanoke; E. J. Hughes, also of Interstate; Maximon; Al Mendaloff, S&M Contractors Service, Statesville, N. C.; Herbert Hales, W. M. Hales Co., Danville, Ill., and Clyde Bunting, Bunting Tractor Co., Boise, Id.

OFFICERS of newly organized tractor rebuilders association are, seated left to right, President Sam Maximon and chairman of Steering Committee, William Hilts. Standing, Clarence Goss, treasurer, Edwin Hess, vice president and Harry Cooke, secretary.

Also included at the recent convention were talks by Jim Wright, Haynes Stellite Co., Kokomo, Ind.; C. Blaine Duncan, Sight Feed Generator Co., West Alexandria, O.; Ivan R. Bartler, Automatic Welding Co.; Walter Storm, Westrac Co., Torrence, Calif.; and Al Harding, Lempco Automotive Inc., Cleveland. Panel discussions and question and answer periods rounded out the meet.

NOW... permanent WELD RECORDS produced automatically!

The new Epsco Mobile Weld Analyzer records PRESSURE and CURRENT on a REAL TIME base, on permanent easy-to-check charts. (Helps you to meet MIL welding specs in production of such items as missile and air frames.)

Featuring portability and rapid set-up time along with simplified chart-paper handling and operational ease, the Epsco Weld Analyzer makes it easy to set-up proper welding control procedures and then, to maintain consistent weld quality.

Special 2-channel recording unit, with trouble-free ink-writing system, gives accurate and simultaneous weld records having uniform trace width and density. Instrument is fitted with rubber-tired, non-static, self-locking casters to facilitate quick movement between welding locations and through explosion hazard areas.

Write for Technical Data Bulletin 91.1 A1.

Epsco

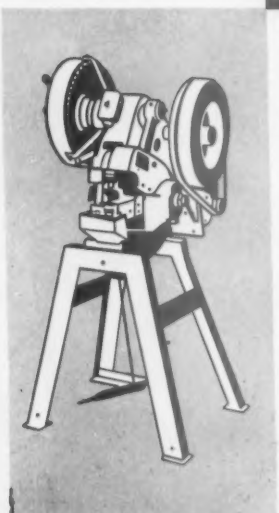
EDIN DIVISION • EPSCO, INC. 588 Commonwealth Avenue, Boston 15, Massachusetts

with ALL-STATE special alloy rod
broken · cracked
CAST IRON
can be chamfered · cut · welded in place

Weldors demand All-State's family of electrodes for cast iron repairs • less dismantling • low cost • low heat.

All-State Distributor stocked everywhere! Convenient to buy! Economical to use!
ALL-STATE WELDING ALLOYS CO., INC., White Plains, N.Y.

BATEMAN
BANTAM
IRON WORKER



THE ONLY IRON WORKER OF ITS KIND ON THE MARKET TODAY

No Grinding Necessary After Cut. One Stroke Cycle Clutch Operater by Hand or Foot

The Bateman "Bantam" cuts 2" x 2" x ¼" angles and ¼" x 4" flats. Standard punches will fit this machine. The Coper will cope 1¼" through ⅛" material. It will punch ½" hole through ¼" material. With the clutch open, the Bantam will make 44 strokes per minute. It is made of high-grade cast iron, with the clutch, pin and dog made of hardened steel. The blades are made with tool steel. It is powered with a fly wheel and gear drive, and uses a small ¾ hp motor, 1750 rpm.

Bateman Bantam with punch....$575.00
Shear only $495.00
Shipping wt. 750 lbs.

WRITE TODAY for complete information and name of nearest distributor

BATEMAN FOUNDRY & MACHINE
MINERAL WELLS, TEXAS

Santa Clara section holds structural lecture series

The Santa Clara Valley section of the American Welding Society will conduct a six-lecture series on welding structural metals at San Jose State College, San Jose, Calif., during February.

Welding of stainless steel, magnesium, aluminum, nickel alloys and reactive metals will be covered.

Oakite celebrating Golden Anniversary

Oakite Products Inc., New York City, is celebrating its 50th anniversary this year. The company was started in New York City, Feb. 2, 1909.

Frederic Hess honored by Franklin Institute

Frederic O. Hess, president of Selas Corp. of America, Dresher, Pa., has been awarded Franklin Institute's Walton Clark Medal for developing new processes for the industrial use of gas.

Hess has authored 55 papers and articles, and has had 55 patents issued in his name. He is credited with achieving closer control over temperatures of natural gas by developing burners made of exceptionally high heat-resistant refractory material.

Gulton changes division name

Gulton Industries Inc., Metuchen, N. J., has changed the name of its Glennite Instrumentation division to Gulton Instrumentation Div.

All-State Institute graduates five teachers

All-State Institute of Advanced Welding, the technical teacher-training facility of All-State Welding Alloys Co., Inc., White Plains, N. Y., has given certificates to five instructors.

The new teachers are John K. Knoll, Knoll Welding Supply, Topeka; David Breslow, Lincoln Welding Supply Co., Lincoln, Neb.; Don Green, Northwest Oxy-Acetylene Dist. Co., Wichita; Robert Renshaw, Herr Welding Supply, Harrisburg, and Barney Waite, Goss Bros. Welding Supply, Walls Greek, Pa.

The course, conducted by John Donnelley, included instruction on non-routine problems of metals joining. Emphasis was on new alloys and fluxes, and on techniques of teaching their use and application to others.

Pipeline News

The Federal Power Commission has approved a budget-type application by Transcontinental Gas Pipe Line Corp., Houston, for the construction and operation of lateral and field facilities. Total cost will be $4,000,000, but no single project authorized will cost more than $500,000.

Northern Natural Gas Co., Omaha, has FPC authorization to construct and operate $4,000,000 of natural gas facilities.

In another move, Northern was given permission to construct Texas and Oklahoma facilities at a cost of $3,152,700. It will add 2,000 hp to compressor stations at Sunray, Tex., and Beaver, Okla., and construct 19.2 miles of 30-in. line near Beaver. New facilities will enable Northern to receive an additional 50,000,000 cu ft of gas daily from its affiliate, Permian Basin Pipeline Co., Omaha.

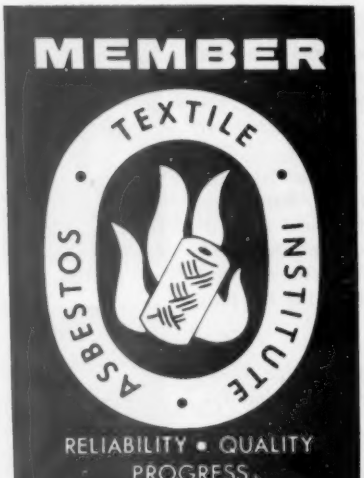
United Gas Pipe Line Co., Shreveport, may build facilities at a cost of $3,000,000, says the FPC.

FPC has authorized Arkansas Louisiana Gas Co., Shreveport, to construct up to $2,850,000 in natural gas pipeline facilities during the year.

Distributor appointments

Joy Mfg. Co., Electrical Products Div., St. Louis: Graybar Electric Co., New York City.

Harnischfeger Corp., Milwaukee: Compressed Gas Sales Co., Wichita Falls, Tex.; Compressed Gas Inc., Abilene, Tex.; Four R Industrial Supply Co., Borger and Pampa, Tex.; Sommerfield Welding Supply Co., Oshkosh, Wis.



SYMBOL, recently adopted by Asbestos Textile Institute, Philadelphia, will appear on product labels of member companies.

Here, in one compact bulletin, is the information that can help you choose the right cylinders for transporting and distributing all types of high-pressure gases—including oxygen, nitrogen, argon, ethylene and carbon dioxide.

Here, too, are related the facts that show why *deep drawn* high-pressure gas cylinders are most likely to save you money on shipping charges, handling costs and maintenance.

Complete data are given—showing styles, sizes, capacities of cylinders, and ICC specifications which Hackney cylinders far exceed.

Whether you serve industrial, commercial or medical customers, you ought to have this new bulletin handy as a guide to quality and as an aid in ordering.

mail the coupon today!

Pressed Steel Tank Company
1456 S. 66th Street
Milwaukee 14, Wisconsin

Gentlemen: Please send the new bulletin at once. We are interested in facts and prices of Hackney high-pressure gas cylinders for ☐ industrial, ☐ commercial, ☐ medical service; in quantities 1 to 24 ☐, 25 to 99 ☐, 100 to 499 ☐, 500 to 999 ☐, 1000 or more ☐.

Firm Name.....

Your Name.....

Address.....

City.....Zone.....State.....

Pressed Steel Tank Company
Manufacturer of Hackney Products Since 1902
Hackney

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Branches in principal cities

CONTAINERS AND PRESSURE VESSELS FOR GASES, LIQUIDS AND SOLIDS

Really FIVE TOOLS in ONE

Yes, actually a BOYCE Centering Head replaces

- ✓ The Protractor
- ✓ The Centerhead
- ✓ The Center Punch
- ✓ The Level
- ✓ The Scale

Determines Center Line at any Degree and Measures Degree of Declivity

Weighs only 9 ozs. Pocket size.

DIAL SET LEVEL

Y type head accurately machined with tangents and tips for centering and aligning. Dial Set Level in graduations of 2½ and 10 degree markings. Punch of Drill Rod with hardened point—insuring long service. Send for complete description.

CONTOUR MARKER CORP.
1843 E. Compton Bl., Compton, Cal.
Also Mfgs. of Contour Markers, Radius Markers and Pipe Flange Aligners.

BOYCE CENTERING HEAD

Get the exact current for quality welding!

USE THE TONG-TEST AC-DC AMMETER

Don't assume your welders are using the right amperage. *Be certain* by controlling welding quality with the Columbia Tong Test AC-DC Ammeter, the only clamp-type instrument that measures both alternating and direct current. Snap tongs around the electrode cable for instant readings. Available in five types with interchangeable ranges up to 1000 amperes. Impossible to read wrong scale. No coils or wires to burn out—no electrical connections needed.

COLUMBIA

Write for illustrated 8-page Catalog WE-400

COLUMBIA ELECTRIC MFG. CO.
4561 Hamilton Avenue • Cleveland 14, Ohio

About people . . .

Lenhard

MacIntyre

Provencher

Gage

R. E. Lenhard has been appointed president of Air Reduction Sales Co., New York City. He succeeds *J. H. Humberstone,* vice president of Air Reduction Inc., who will devote himself to corporation affairs.

Archie A. MacIntyre has been appointed eastern Michigan sales representative for United Specialties Inc., El Dorado, Ark.

Pyromet Co., San Francisco, has made three staff appointments. *A. W. Land* is brazing and plant engineer, *Arndt C. Fortlage* is production manager and *Robert C. Bertossa* is technical director.

Wilmot F. Wheeler, Sr., has resigned as chairman of the board and chairman of the executive committee of American Chain & Cable Co., Inc., New York City. He was with the company 42 years. Former vice president of the company, *Wilmot F. Wheeler, Jr.,* has been elected executive vice president and a director of the corporation.

Former New England district manager for Arcos Corp., Philadelphia, *Alfred Provencher,* has been appointed Chicago district manager. *Carl Gage* replaces Provencher.

Clayton D. Grover, president of Whitehead Metals Inc., New York City, has been elected chief officer of the company. *Thomas M. Bohen,* associated with the company since 1914, has been elected honorary chairman of the board of directors.

L & B Welding Equipment Co., Berkeley, Calif., has appointed *John C. Lindgren* its new general sales manager.

J. K. Gannett, vice president in charge of all engineering and research for the Austin Co., Cleveland, retired at the beginning of the year.

Clarence T. Gilchrist has retired as western area sales manager of the American Steel and Wire Div. of United States Steel Corp. *B. M. Ashbaucher* has been named to succeed Gilchrist.

Kartalia

Mitchell P. Kartalia has been elected vice president of Square D Co., Detroit. He will be responsible for the company's entire marketing program.

McElhoe

The new general sales manager of the Southern Sales Div. of National Welding Equipment Co., San Francisco, is *H. L. McElhoe.* He was formerly with Smith Welding Equipment Corp. and served as director of training for the company during the past year.

Barris

New general manager of the Stainless Processing Div. of Wall Colmonoy Corp., Detroit, is *G. A. Barris.*

Dick

Charles M. Dick has been appointed product manager of electrodes by Metal & Thermit Corp., New York City. He is responsible for sales planning and customer service.

Norton Co., Worcester, Mass., has made several personnel changes. *Donald L. Price,* formerly sales manager of grinding wheels for the Abrasive Div., has been elected a vice president. *Robert Cushman* has been named Price's successor. *Harry G. Brustlin* is the new marketing services manager replacing Cushman. Brustlin is being replaced by *Sidney B. Wetherhead. Wilfred R. Ogg,* former Chicago district manager of the company's Grinding Machine Div., is now manager of distributor sales for the division. *Calvin K. Kirk* succeeds Ogg. *Frank M. Ryan* is now vice president and general manager of the company's Norton Behr-Manning Overseas Inc. division. *Fordyce B. Scott* was named vice president in charge of Behr-Manning tape and coated abrasive products. *Louis J. Camarra,* former European regional manager, returns to Worcester as vice president in charge of sales of abrasive and refractory products.

Detroit Stamping Co., Detroit, has made four changes in its organization. *Harry C. Robeson,* a director since 1953, was elected vice president of sales of all company products. *William H. Roberts* is executive vice president, *Herbert McMillan* has been appointed sales manager of the Stamping Div. and *Charles Hoppe* is sales manager of the Finished Products Div.

Tom Earlbeck has joined Earlbeck & Landrum Inc., Baltimore, as a welding technician trainee. He will receive training in the sales, rental and repair functions of the welding supply company.

Robert E. Lewis has been elected president of Sylvania Electric Products Inc., New York City. He succeeds *Don. G. Mitchell,* who continues as chairman of the board. If the proposed merger between Sylvania and General Telephone Corp. goes through it is contemplated Mitchell will become president of the combined company. (See December *WW*, p. 13.)

Nedco Co., Waltham, Mass., has appointed three manufacturer's representatives. *J. S. Longdon,* Longdon Sales, Greensboro, N. C., is in charge of sales in the Carolinas, Virginia, Maryland and Washington, D. C. *H. M. Rogers* and associate *Kenneth Boomer* will work in Georgia and Florida, and *Warren A. Mundy* will work in Kansas, Nebraska, Iowa and part of Missouri.

BECKER

CARBON
WELDER BRUSHES

for all types and makes of welding equipment

Everything you need from *one* source, with *one* responsibility. The fast, economical way to order. Catalog gives complete specifications, factory numbers, scaled drawings, etc. Write for your free copy today.

WHOLESALERS:
Some Distributorships still open.
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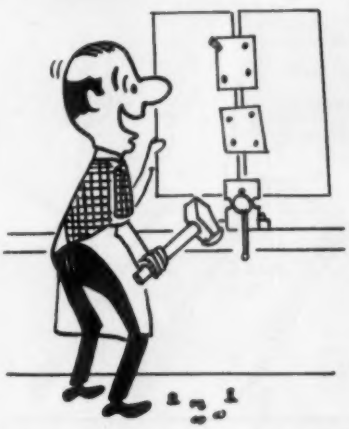
REDUCE WELDING COSTS
BY PROPER CARE OF
ARC WELDING CIRCUITS
AND REMEMBER

WELD IT WITH HI-AMP
ELECTRODE HOLDERS



- 30% More Heat Resistant than any other make.
- Brilliant Red and Yellow Glass Fibre Colors insures identification of Holder anywhere in plant—Valuable Safety Feature.
- Low initial cost, easy and economical to maintain.

Sold only through Welding Supply Distributors throughout the U.S. and Canada.

LENCO, Inc.

Eliminates Spatter Grinding After Welding

YORK'S *SPAT-R-PRUF* COMPOUND 106

THREE *EASY* STEPS

1. Coat Surface
2. Weld
3. Wipe Off

A perfect paint base. No stirring or dilution necessary. No grinding after welding—spatter can be wiped away with a dry cloth.

IMPORTANT FEATURES

- Non Toxic
- Non Inflammable
- Pleasing Odor
- Harmless to Skin
- Helps Prevent Rust
- No Weld Porosity

Available in 1 gallon cans and 5 gallon cans and 55 gallon drums.

3-IN-1 YORK'S '77' SPECIAL FLUX

- For General Brazing
- For Cast Iron Welding
- For Cast Iron Brazing

A guaranteed bond even under toughest conditions

Available: 1 lb. Cans

YORK ENGINEERING COMPANY

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Miss Liberty says:

"CONFIDENTIALLY I PREFER A *Dockson* TORCH"

Dockson Welding and cutting torches are lighter, better balanced, built to last with rigid, silver soldered one piece construction. Designed to do the job better, faster.

Service parts available from stock.

Check the complete Dockson line of Better Built Welding Equipment. Write for catalog 56-05.

Dockson CORPORATION

3839 Wabash Ave., Detroit 8, Mich.

The Techline Div. of Wheelabrator Corp., Vicksburg, Mich., has appointed five sales representatives. They are *Charles W. Thomas*, Arcadia, Calif.; *Richard D. Taylor*, Phoenix, N. Y.; *Ruel K. Shumway*, St. Louis; *Donald H. Schultz*, Elm Grove, Wis.; and the Industrial Sales & Engineering Co., Inc., Kalamazoo, Mich.

William H. Kaiser, Jr., is the new district equipment sales manager for General Electric receiving tubes in the north-central region. He will headquarter in Chicago.

Died . . .

Verne E. Minich, founder of Wheelabrator Corp., Mishawaka, Ind., died Dec. 13, 1958, at the age of 91. Mr. Minich was honorary chairman of the board of directors at the time of his death.

A heart attack proved fatal to 63-year-old *Ralph Crysler McQuire*, manager of the Nickel Refining Div. of International Nickel Co. of Canada. Mr. McQuire was a member of the American Institute of Mining, Metallurgical and Petroleum Engineers and the Association of Professional Engineers of Ontario. He was also active in many civic organizations.

Arthur Ray McCall died of a heart attack Dec. 24, 1958, at the age of 52. He represented O.K.I. Welding Supply Co., Cincinnati, in northwest Ohio and eastern Michigan. Mr. McCall also was a welding instructor for the evening welding classes conducted by the public schools of Findlay, O., where he lived.

Ernest F. Meier, technical assistant to the general manager of Glascote Corp., a division of A. O. Smith Corp., Cleveland, died Dec. 5, 1958. Mr. Meier was one of the pioneers of welding in the St. Louis area. He was in charge of welding during most of his 30 years with Monsanto Chemical Co.'s St. Louis plant. He also was a past chairman of the St. Louis section of the American Welding Society.

James M. Johnston, general sales manager of Weltronic Co., Detroit, died Nov. 11, 1958, at the age of 65. Prior to working with Weltronic, Mr. Johnston was supervisor of resistance welding for Murray Corp. of America. He also worked with Dodge Div. of Chrysler Corp.

30 YEARS AGO

(Taken from the *Welding Engineer* of February, 1929.)

—30 YEARS AGO—

"Welding appears as national necessity," is an editorial citing the advantages of the all-welded battleships produced by Germany. Among other advantages, the operating capacity of the ships is increased without increasing their weight.

—30 YEARS AGO—

Part 1 of a series deals with selection of proper welded joint design for different airplane parts. Joints that have been satisfactorily used are pictured.

—30 YEARS AGO—

New splice design performs two functions. It provides joints equal in strength to girders and serves as a stiffener for web and flanges.

—30 YEARS AGO—

"Oxyacetylene cutting structural steel" is an article contrasting shearing and torch cutting. Article points out that torch-cut surfaces are less apt to crack than sheared surfaces, and that torch cutting does not distort metal.

—30 YEARS AGO—

Welded pipe is being used in the construction of the Cathedral of St. John the Divine in New York City. The pipe is being buried in 20 ft of masonry after being welded and coated. Confidence in welding is displayed since pipe will be inaccessible if leak should occur.

—30 YEARS AGO—

The largest copper still in America, owned by United States Industrial Alcohol Co., Peoria, Ill., was brazed with silver solder supplied by Handy & Harman Co., New York City.

—30 YEARS AGO—

Two portable gas-engine generators are supplying power for electric arc-welding being used to repair Chicago bridges and viaducts.

—30 YEARS AGO—

The Mississippi Valley Structural Steel Co., Melrose Park, Ill., has electrically arc-welded four pile drivers for the Walsh & Masterson Co., Chicago. Each 81 ft unit operates a 10,350 lb steam hammer.

NATIONAL CARBIDE
IN THE RED DRUM

HIGHEST QUALITY

DUST FREE

DEPENDABLE SUPPLY

Write for the name and address of the NATIONAL CARBIDE supplier nearest you.

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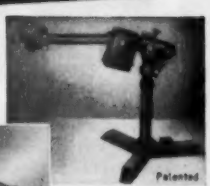
AT THE FRONTIERS OF PROGRESS YOU'LL FIND AN AIR REDUCTION PRODUCT

ARONSON
Offers You Over 200 PROVEN Standard Stock Models of Quality POSITIONERS "POSITIONEERED" to your exact Requirements

Patented

Aronson TracTread (T. M. Reg.) Turning Rolls for thin-walled heavy cylindrical work to 27 tons capacity. Zero to 100 IPM. turning speed and Built-In Grounding.

Aronson Universal Balance Positioners (T. M. Reg.) position your weldments effectively, instantly for downhand welding. Capacities to 2000 lbs.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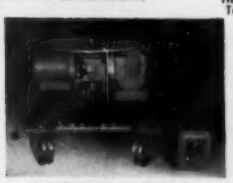

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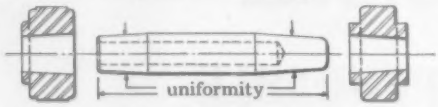

And in converting this high-quality bar stock to welding tips, Tuffaloy insures conformity to all standard dimensions. Before shipment all tips must pass inspection by gage for uniformity in length, Morse taper, and the outline of the point.

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51. TRANSFORMERS—M&T Welding Products Co. Brochure VVT-1 gives design and construction characteristics of heavy-duty variable voltage transformers.

52. WELDING EQUIPMENT—Raytheon Mfg. Corp. Bulletin 900 details small part welding equipment and ultrasonic impact grinders.

53. ULTRASONIC CLEANERS — Narda Ultrasonics Corp. Data Sheet No. 1500 details company's latest addition to its line of mass-produced production size Sonblaster ultrasonic cleaners. Compares generator Model G-1501 in capacity, power and performance with higher priced ultrasonic equipment.

54. TUMBLING ABRASIVE—Simonds Abrasive Co. Brochure describes Borolon aluminum oxide tumbling chips and grain for use with dry or wet equipment.

55. SPOT WELDERS—Taylor-Winfield Corp. Bulletin 2-013A describes line of EB-1 air- or foot-operated bench-mounted spot welders.

56. CUTTING TORCH—Linde Co. Oxweld flame-cutting equipment is described in folder F-1174. Includes sampling of nozzles available.

57. JIG SYSTEM—Wharton Unitools. Unitube jig system designed to replace permanent welding fixtures is described in *Aviation Age* reprint.

58. GOUGING ELECTRODE—Kenco. Chamferarc, electrode for gouging, grooving, chamfering and routing of ferrous and non-ferrous metals, is explained in flyer.

59. HARDFACING—Metallizing Engineering Co., Inc. Bulletin 139 details ThermoSpray gun for hardfacing with tungsten carbide. Includes pictures of gun in action and its parts.

60. TERMINAL BLOCK—Square D Co. Bulletin 9080-H explains company's fusible terminal block for fuse protection of solenoids and single or three-phase loads.

61. RESPIRATOR—American Optical Co. Flyer S-8093 tells of Red Devil filter for protection against dusts no more toxic than lead and chromic-acid mists.

62. HOLDER—Climax Corp. Twin-head electrode holder is pictured in catalog supplement.

63. THERMOPLASTIC WELDER—Laramy Products Co. Thermoplastic hand-welders for tack, production and job welding are described in booklet.

64. JET ENGINE REPAIR—Sciaky Bros. Inc. "Overhaul and repair of jet engines and airframes" is an engineering report which covers use of seam, spot and flash-butt resistance welding.

65. LIFTING DEVICE—Merrill Bros. Automatic safety lock fork-lift attachment designed to convert any fork-lift truck into an overhead lifting unit is covered in flyer.

66. WELDING EQUIPMENT—Harnischfeger Corp. Complete line of P & H welding equipment is pictured in brochure W-112-1.

67. DISTRIBUTION SYSTEM—National Cylinder Gas Div. N-125 points out production, space and cost benefits of con-

tinuous distribution of industrial gases by custom-built manifold installations.

68. WELDING SCREEN—Singer Glove Mfg. Co. Catalog supplement details portable welding screens with new materials and standard screens with 12 oz fire resistant duck.

69. METALLIZING WIRES—SpraRod Corp. Folder contains sizes, weights and prices of line of metallizing wires.

70. ALUMINUM STUD WELDING—Nelson Stud Welding. Brochure describes stud welding method and NS-10A portable gun and timing control unit with adaptor.

71. SILVER ALLOYS—Eutectic Welding Alloys Corp. Manual TIS 2840 contains comparative analysis chart for company's silver-bearing alloys, and details heating techniques.

72. FOIL WELDER—Gulton Industries Inc. Ultrasonic foil welder Model UW-100A, for sealing aluminum and thin sheet metals when packaging, is covered in bulletin UL-150.

73. INDUCTION HEATING — Hobart Bros. Co. Pamphlet DM-74 tells of a 400-cycle induction heating generator and how it simplifies preheating and stress relieving of arc-welded joints.

74. INSPECTION MATERIAL — Magnaflux Corp. Uses and specifications on Spotcheck, a dye penetrant inspection material in spray cans, are given in brochure.

75. WELDING RODS — American Brass Co. Anaconda welding rods and procedures for welding copper and copper alloys are covered in publication B-13.

76. GAS WELDING, CUTTING—Harris Calorific Co. Catalog 586 details welding and cutting torches and tips, regulators and accessories.

77. JAW CLEANER—Atlas Welding Accessories Inc. Electrode holder jaw cleaner is described in flyer. Uses, advantages and prices included.

78. STAINLESS STEEL — Armco Steel Corp. Booklet contains information on ELC stainless steel. Covered are types 304L and 316L, said to prevent carbide precipitation in stainless steel weldments.

79. WATER SAVER—Van Vooren Products. Watermizer, for use with resistance welders, induction heaters or other water cooled equipment, is covered in flyer.

80. ORNAMENTAL IRON — Tennessee Fabricating Co. Catalog T-123 covers line of standard, adjustable iron columns and rails.

81. SPOT WELDERS—National Electric Welding Machines Co. Three-phase frequency converter-type spot and seam welders for aircraft industry are detailed in Vol. 11, No. 4 of *Welding News*.

82. BRAZING—Handy & Harman. Silver alloy brazing is described in *Brazing News* No. 79. Uses and pictures are included.

83. CHIPPING HAMMER — Ingersoll-Rand. Specifications, uses and pictures are included in form 5229, which covers shock-absorber chipping hammer.

84. A-C WELDER—Ergolyte Mfg. Co. Model FA 181 is a limited input a-c welder for farm and shop use that is detailed in flyer.

85. WELDING CONTROL—General Electric Co. GET-2683 uses 18 diagrams, charts and drawings to explain company's non-synchronous resistance welding control.

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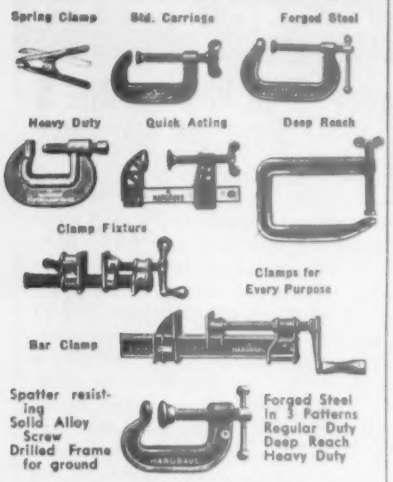

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86. HARDFACING—Wall Colmonoy Corp. Engineering data sheet 21 tells of content, properties and applications of Colmonoy 75, a tungsten carbide hardfacing powder.

87. BRONZE ELECTRODES — Ampco Metal Co. Reference data charts on bronze welding electrodes and filler rods contain information on melting rates, efficiencies, welding currents and comparative bronze electrodes.

88. SADDLES—Tube Turns. Dimensional data, cyclic life and correct welding procedures for company's full-encirclement saddle are given in bulletin TT 866.

89. MOLDING COMPOUND — Devcon Corp. Plastic Steel for making jigs, fixtures, etc., is covered and pictured in use in bulletin NI-103.

90. MANIPULATORS — Cayuga Machine and Fabricating Co., Inc. Welding head manipulators are pictured and advantages given in catalog 5705.

91. MIG WELDING—Linde Co. F-8279 tells of company's SWM-3 Mig welding machine. Includes pictures and specifications.

92. ARC WELDERS — Emerson-Electric. Specification sheets are available on company's 180 and 295 amp a-c arc welders and 200-amp d-c industrial engine-driven arc welder.

93. SPOT WELDER—Taylor-Winfield Corp. Recommended welding schedules for spot welding Inconel X in thicknesses of 0.032 to 0.188 in. are given in bulletin SP-20. Also covered are machine's properties, postweld heat and forging pressure and charts and graphs.

94. ULTRASONICS—Acoustica Associates Inc. Line of ultrasonic equipment, including that used for cleaning and degreasing, is covered in bulletin BB-100.

95. BUTT WELDING—Robert Hoffman Co., Inc. Sheet tells of automatic butt-welding attachment that can be used with spot welder.

96. FLAME CUTTING — Air Reduction Sales Co. ADC 673 explains No. 20 Radiagraph, a portable, motor-driven, straight-line, track-guided cutting machine.

97. X-RAY—Gevaert Co. of America. Handbook on industrial X-ray films contains comparison table, technical data and curves on five films.

98. ALLOY WALL CHART — All-State Welding Alloys Co., Inc. Welding shop wall chart covers 89 specialty alloys and fluxes, tells when they should be used and criteria to be considered.

99. PORTABLE WELDER—Lincoln Electric Co. Leaflet covers "Weldanpower," Portable welder that supplies power. Pictures uses, gives specifications.

100. POLISHING AND BUFFING—Divine Bros. Co. Polishing and buffing machinery with belt, buff or wheel is covered in folder 558-ML-1.

110. TRAP MAINTENANCE — Tempil Corp. "Something new in trap maintenance" is 2-page reprint dealing with use of temperature indicating crayons.

115. STEELS—A. O. Smith Corp. "Welding steels and electrodes, their composition and comparisons," is a booklet giving data on mild steel electrodes, stainless steel and cast iron, etc.

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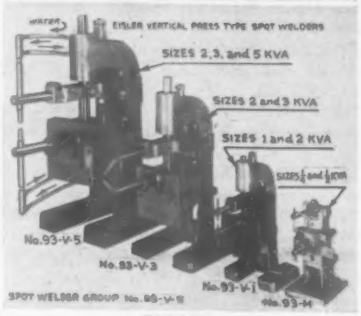

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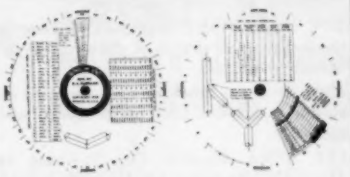

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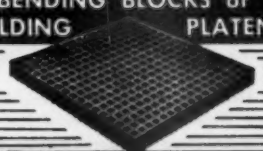

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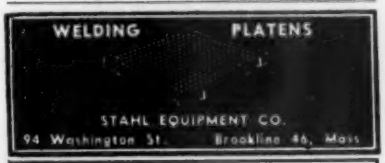

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125. Air Reduction Sales Co.—Further information available on "Airco" 3-tube cutter.

126. Alloys Rods Co.—Bulletin HS-102 on the "Wear-O-Matic" process to increase production.

127. All-State Welding Alloys Co.—Instruction manual covering the whole line of All-State equipment.

128. Ampco Metal, Inc.—Bulletin W-17 gives detailed facts on "Ampco-Trode" electrodes and bronze weldrods.

129. Anti-Borax Compound Co.—Descriptive booklet and sample of the new "Royal" hardening powder.

130. Aronson Machine Co.—Detailed engineering data available on Aronson's positioners.

131. ASEA Electric Co.—Brochure on "Type SVU Aseavets" automatic flash welding machines.

132. Atlantic Abrasive Corp.—Atlantic Grinding Wheels catalog to help you in any type of metal removal or smoothing problems.

133. Atlas Welding Accessories Inc.—Further information on the new "Wide Blade" chipping tools.

134. Bateman Foundry & Machine—Complete information on the "Bantam Iron Worker", also name of nearest distributor.

135. Bay State Abrasive Products Co.—For cost-cutting ideas write for name and address of your "Bay Sate" distributor.

136. Becker Brothers Carbon Co.—Catalog giving complete sepcifications and scaled drawings of carbon welder brushes.

137. Bernard Welding Equipment Co.—Further information available on Bernard's "Shortstub" electrode holders.

138. Cam-Lok Div.—Bulletin No. 301 available on the complete line of Receptacles and Plugs.

139. Carol Cable Co.—Information on Carol's "Dynapower" welding cable.

140. Cincinnati Tool Co.—Catalog on clamps for every purpose.

141. Columbia Electric Mfg. Co.—Illustrated catalog on tong-test ac/dc ammeter.

142. Contour Marker Corp.—Details on establishing and marking a point at any angle.

143. Contour Marker Corp.—Information and instruction book on laying out pipe joints.

144. Dockson Corp.—Further information on Dockson torches available.

145. Drawalloy Corp.—Bulletin 355-DC provides complete information on every grade of Drawalloy welding wire.

146. Duro Engineering Co.—Information on the standard holder and the "Durogon" holder.

147. Eastman Kodak Co.—Data available on Kodak industrial type "AA" film.

148. Eisler Engineering Co., Inc.—Catalog 93-57 on spot and wire butt welders and the vertical type press welder.

149. Epsco Inc.—Write for technical

(Continued on page 90)

AD INDEX

This advertisers' index is included as a convenience and is in no way a part of the advertising contract. Although every care has been taken to index accurately, some errors may have occurred and no allowance will be made for them.

Air Reduction Sales Co. 17
Air Reduction Sales Co. Tuffaloy Dept. 84
Alloy Rods Co. 21
All-State Welding Alloys Co., Inc. 78
American Chain & Cable Co., Inc. Page Steel & Wire Div. 67
Ampco Metal, Inc. 49
Anti-Borax Compound Co. 86
Aronson Machine Co. 83
ASEA Electric Inc. 63
Atlantic Abrasive Corp. 73
Atlas Welding Accssories Inc. 20

Bateman Foundry & Machine 78
Bay State Abrasive Products Co. 22, 23
Becker Bros. Carbon Co. 81
Bernard Welding Equipment Co. 5

Cam-Lok Div. 70
Carol Cable Co. ..... Inside Front Cover
Cincinnati Tool Co. 86
Columbia Electric Mfg. Co. 80
Contour Marker Corp. 52, 80

Dockson Corp. 82
Drawalloy Corp. 18
Duro Engineering Co. 15

Eastman Kodak Co. 47
Eisler Engineering Co. 86
Epsco, Inc. 77
Eutectic Welding Alloys Corp. 53

H & M Pipe Beveling Machine Co. 85
Harnischfeger Corp. 61
Harris Calorific Co. 4
Haynes Stellite Co. 57
Hobart Bros. Co. 1, 2

International Nickel Co. ..... 24, Back Cover
Invincible Vacuum Cleaner Mfg. Co. 76

Jackson Products ..... Front Cover

Lenco, Inc. 81
Linde Co. 26

Merrill Brothers 59
Maitlen and Benson, Inc. 43
Mallory & Co. 69
Metal & Thermit Corporation 14
Metalloy Products Co. 58
Miller Electric Mfg. Co., Inc. 19

National Carbide Co. 83
National Welding Equipment Co. 9
Norton Co. 16

Oxo Equipment Co. 85

Page Steel & Wire Division American Chain & Cable Co., Inc. 67
Phelps Dodge Copper Products Corp. 12
Picker X-Ray Corp. 55
Pressed Steel Tank Co. 79

Ruemelin Mfg. Co. 52

A. O. Smith Corp. 10, 11
Shawinigan Products Corp. 59
Shoot-A-Lite Corp. 86
Sperry Products Inc. 51
Stoody Co. 45
Stulz-Sickles Co. 84

Tec Torch Co., Inc. 74
Tempil Corp. 72
Thermacote Co. 58
Tuffaloy Dept. of Airco 84
Tweco Products, Inc. ..... Inside Back Cover

United Specialties Inc. 46

Victor Equipment Co. 6, 28

Westinghouse Electric Co. 64, 71

York Engineering Co. 82

WELDING INFO-AIDS

USE THIS CARD for Literature, Catalogs, and Bulletins shown on preceding pages and for those featured in this month's ads as listed opposite and on following page

Also information about

NEW PRODUCTS described on pages 66 to 74

Every month WELDING ENGINEER lists many new catalogs and bulletins available from manufacturers. All are yours for the asking. However, this service is valuable to you only if you use it.

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★ For copies of any manufacturers' bulletins described on these pages, circle the number of the items on card at right. Fill in your name, title, company and address. This has to be done only once on either post card. You need no postage.

★ For additional information on New Products described in this issue, circle the numbers of the items that interest you. The New Products section begins on page 66.

WARNING!

Illegible or incomplete addresses may keep you from receiving the information you desire. And remember, cards postmarked after the deadline date cannot be processed.

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data bulletin 91.1 A1 on the new "Epeco Mobile Weld Analyzer."

150. Eutectic Welding Alloys Corp.—**Name and address of your local Eutectic technical representative to consult with you on your welding problems.**

151. H & M Pipe Beveling Machine Co.—**Illustrated catalog sheets on the pipe cutting and beveling machines.**

152. Harnischfeger Corp.—Bulletins **R-29 and R-26 available on P & H low hydrogen electrodes.**

153. Harris Calorific Co.—Further **information on Multi-Stage 77 gaugeless regulator.**

154. Haynes Stellite Co.—Write for **"Haynes Alloys Hard-Facing Manual."**

155. Hobart Brothers Co.—Complete **details on Hobart's new multi-range arc welders.**

156. Hobart Brothers Co.—Sample **available of the new No. 12A mild steel electrode also catalog on welding electrodes and accessories.**

157. International Nickel Co.—Com**plete data and suggested procedures for using Inco-Hard "1" electrode are given in a new 8-page data sheet.**

158. International Nickel Co.—"Now You Can Weld Dissimilar Alloys Quickly and Easily" includes actual case histories of problem welds.

159. Invincible Vacuum Cleaner Mfg. Co.—Send for folder on Invincible flux recovery systems.

160. Jackson Products—Further information available on Jackson's insulated electrode holder, the "Quik-Trik" cable connector and the "Cablehitch" for overhead suspension of welding cable.

161. Lenco, Inc.—Data on Lenco's "Hi-Amp" electrode holders.

162. Linde Co.—Write for further information on "Unionarc Welding."

163. Maitlen and Benson, Inc.—Information on "Wypo" cutting and welding tip cleaners.

164. Mallory & Co.—Wall chart of "Do's and Don'ts of Resistance Welding."

165. Merrill Brothers—Information on material handling devices available.

166. Metal & Thermit Corp.—Further information available on the 3 new "M & T" welders: Liquid cooled engine-drive welder; Air cooled-engine drive welder and motor-generator welder.

167. Metalloy Products Co. — Testing samples of "Galvalloy" available for your galvanizing job.

168. Miller Electric Mfg. Co.—Complete particulars on the engine driven welder power plant.

169. National Carbide Co.—Information on calcium carbide and name of nearest distributor.

170. National Welding Equipment Co.—Catalog No. 16 on the new triplex oxygen regulator for three-hose flame cutting torches.

171. Norton Co. — Further information available on Norton's grinding wheels.

172. Oxo Equipment Co.—Information on Oxo regulators available.

173. Page Steel & Wire Div.—Welding wire packaging chart, and comparison chart available, also submerged arc and inert gas welding wire folder and gas welding rod booklet.

174. Phelps Dodge Copper Products Corp.—Further information on Phelps Dodge "Habirprene" arc welding cable.

175. Picker X-Ray Corp.—Further information available on the new "Andrex" x-ray unit.

176. Pressed Steel Tank Co.—Bulletin "Seamless High Pressure Gas Cylinders" available.

177. Ruemelin Mfg. Co.—Detailed information on the Ruemelin fume collector.

178. Shawinigan Products Corp.—Information on calcium carbide and name and address of nearest distributor.

179. Shoot-A-Lite Corp.—Literature on "Safety Gas Liter" for welding and cutting torches.

180. A. O. Smith Corp.—Write for further information on the A. O. Smith convertors; to convert any a-c welder to d-c.

181. Sperry Products, Inc.—Information on the "Reflectoscope" and the Ultrasonic news letters are available.

182. Stoody Company—Further information on hard-facing alloys and name and address of your nearest dealer.

183. Stulz-Sickles Co.—Details on ways to solve your severe abrasion problems.

184. Tec Torch Co., Inc.—Full information on the "Tec Spot Gun" and other 'Visuweld" equipment.

185. Tempil Corp.—Information and sample pellets of temperature indicators; state temperature desired.

186. Thermacote Co.—Write for complete descriptions of "Thermo" filter plates and cover lens.

187. Tuffaloy Dept. Air Reduction Sales Co.—Catalog and prices on Tuffaloy spot welding tips, tip holders and adapters.

188. Tweco Products Co.—Write for "Twecolog" showing the complete line of Tweco accessories.

189. United Specialties, Inc.—Information on "Weldreel" hose and cable reels.

190. Victor Equipment Co.—Further information on semi-automatic wire also information on dealerships.

191. Westinghouse Electric Corp.—Information on the full line of industrial radiographic-fluoroscopic equipment is available.

192. York Engineering Co.—Further information available on York's "Spat-R-Pruf" to eliminate spatter grinding after welding.

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DOWN-TO-EARTH FACTS about electrode holders

A vital link in an arc welding circuit, the electrode holder performs several functions. Its jaws must have a powerful bite on various sizes of electrodes. Its design must let the weldor change rods quickly, be comfortable to handle and run cool within its rated amperage. It must have an easy, quick, efficient means for attaching the welding cable. Its insulation must withstand tremendous heat and impact.

Only TWECOTONG ELECTRODE HOLDERS offer all these features:

Super-Mel Insulation. Won't Break, Won't Burn, Won't Char.
All parts are replaceable.
Tong type, easy to change rods. Runs cool.
Powerful rod grip. All position.
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Inco-Weld "A" Electrode joins high-strength low-alloy steel and 304 stainless, in 45 ft by 12 ft diameter pressure chamber. Fabricated by O. G. Kelley and Co., Boston, Mass.

Inco-Weld "A" joins most dissimilar alloys in nuclear applications, too

The 4 weldors above are all using Inco-Weld* "A" Electrode. They're welding high-strength low-alloy steel *and* 304 stainless on a 160-ton nuclear components testing chamber.

Two other popular electrodes failed on test welds for this job . . . weld metal cracked from differing thermal expansion rates between the dissimilar metals joined.

Inco-Weld "A" Electrode solved this problem . . . produced X-ray quality weld throughout; with corrosion resistance equal to parent metal.

Better than 97% of *all* weldable dissimilar alloys can be joined with both Inco-Weld "A" Electrode and Inco-Weld "A" Wire. You don't need any special equipment or training to get sound, strong. corrosion-resisting welds.

Useful new booklet "Now You Can Weld Dissimilar Alloys Quickly and Easily" includes actual cases of problem welds solved; costs reduced; with Inco-Weld "A" Electrode and Wire.

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MIG or TIG-Weld dissimilar alloy combinations with Inco-Weld "A" Wire.

You get all the advantages of Inco-Weld "A" Electrode plus an age-hardenable deposit. Available in spools and cut lengths.

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